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SEVENTY—SEVENTH REPORT OF THE STATE GEOLOGIST

ACTIVITIES OF THE CALIFORNIA DIVISION OF MINES AND GEOLOGY JULY 1, 1984 THROUGH JUNE 30, 1985

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FOREWORD

Those who make land-use decisions in both the public and private sectors in California must accommodate the urban expansion and sound economic growth necessary to an expanding population and still enable the maintenance of an acceptable environment. The continued availability of mineral resources needed in our highly industrialized society is an important concern when making land-use decisions. The levels of understanding behind such decisions range from broad general knowledge of California's complex geology and mineral resources to detailed knowledge of the geology and resources of a specific site.

To facilitate these broad and specific processes, the California Department of Conservation's Division of Mines and Geology (DMG) carries out basic and applied geologic investigations of California's geologic environment, and provides information and advice to the general public, to the mining industry, and to local, state, and federal government agencies. Geologic information is available from the three DMG regional information offices. CALIFORNIA GEOLOGY, a monthly magazine, technical reports and maps, and a wide variety of special information pamphlets, including DMG Notes, are the publication vehicles for this geologic information.

All Division activities are based on the principle that knowledge of the fundamental geology of the state is important for the safety and economic well-being of the citizens of California.

CONTENTS

Page

FOREWORD..... iii

DIVISION PROGRAMS..... 1

I. Minerals Program..... 3

1. Mineral resource analysis..... 4
2. Surface Mining and Reclamation Act (SMARA)..... 4
   a. Urban mineral land classification..... 5
   b. Country mineral land classification..... 8

II. Geologic Hazards Program..... 11

1. Landslides hazard identification studies..... 11
2. Fault studies..... 12
3. Marine geology studies..... 13
4. Cooperative studies with county and local governments..... 14
5. Special investigations..... 15

III. Geophysics Program..... 17

1. Earthquake hazard and risk assessment..... 17
   a. Damage scenarios..... 17
   b. Seismic hazard maps..... 18
   c. Seismic monitoring..... 18
   d. Volcanic hazard monitoring..... 19
   e. Southern California Seismic Prospect..... 20
   f. Advisory services..... 20
2. Strong-motion instrumentation..... 20

IV. Environmental Geology Program..... 25

1. Geophysical studies..... 25
   a. Gravity mapping..... 25
   b. Aeromagnetic mapping..... 25
   c. Geophysical projects in support of other investigations..... 26
2. Geothermal resource studies..... 26
3. Mined-land reclamation (SMARA)..... 28
4. Volcanic hazards response planning..... 29

CONTENTS (Continued)

Page

V. Geologic Investigations Program..... 31
1. Fault evaluation and zoning..... 31
2. Regional geologic mapping..... 34
3. Forest watersheds mapping and timber harvest plan review..... 37

VI. Geologic Information Program..... 43
1. Information service and publications sales..... 43
2. Publications production..... 43
a. New publications released..... 44
b. CALIFORNIA GEOLOGY articles..... 47
c. Open-file reports..... 47
3. Geology library..... 54
4. Critical-siting report review..... 54
a. Coastal Commission site reviews..... 55
b. Environmental impact report reviews..... 55
c. Hospital site report reviews..... 55
d. Legislation review..... 55

FIGURES

		Page
Figure 1.	Status of the Urban SMARA Classification-Designation Program.....	6
Figure 2.	Status of the Country SMARA Mineral Land Classification Program.....	9
Figure 3.	Stations of the Strong Motion Instrumentation Program, June 30, 1985.....	23
Figure 4.	Strong motion records from the Morgan Hill earthquake of April 24, 1985.....	24
Figure 5.	Principal faults in California zoned for special studies under the Alquist-Priolo Act of 1972.....	33
Figure 6.	Status of the Regional Geologic Mapping Program -- 1:250,000-scale mapping completed, underway, and proposed at year's end.....	36
Figure 7.	Status of the Forest Watersheds Mapping Program.....	38

TABLES

Table 1.	Facilities instrumented by SMIP during 1984-85.....	22
Table 2.	Available watersheds maps, with open-file number.....	40

DIVISION PROGRAMS

The California Department of Conservation's Division of Mines and Geology (DMG) is the state geological survey of California. As such, its primary function is to provide technical data to assist public agencies and the private sector in the wise and safe use of the earth's crust, its terrain, and its mineral resources. The broad objectives of the Division are: (1) to identify, delineate, and assist in the ultimate utilization of deposits of minerals, both onshore and offshore, consistent with wise conservation practices; (2) to identify and provide timely delineation of geologic hazards; and (3) to compile and, where needed, develop basic data on the geology of the state in support of geologic hazard and mineral resource investigations.

To achieve these broad objectives, the Division carries out a wide range of activities through six basic programs. These are: (1) the Minerals Program, (2) the Geologic Hazards Program, (3) the Geophysics Program, (4) the Environmental Geology Program, (5) the Geological Investigations Program, and (6) the Geologic Information Program. These six programs and their activities during fiscal year 1984-85 are described in the following pages.

Overview

MINERALS PROGRAM

The Minerals Program conducts investigations of mineral deposits and geologic terranes to provide public information on the extent, nature, and magnitude of the state's mineral resources. The goal of the program is to help the people of California and the nation meet future mineral needs. The program's classification of mineral lands according to the significance of the mineral deposits is used in land-use planning and regulatory programs administered by local government. Specific areas of program activity are (1) mineral resource analysis, (2) urban mineral land classification, and (3) nonurban mineral land classification.

GEOLOGIC HAZARDS PROGRAM

The Geologic Hazards Program provides information on geologic hazards, including landsliding, ground rupturing caused by fault movements, ground shaking caused by earthquakes, tsunamis (seismic sea waves), volcanic eruptions, land subsidence, expansive soils, and erosion. The information ranges in use from technical to lay applications. Areas of potential geologic hazard are delineated for land-use and emergency-response planning applications. Specific areas of program activity are (1) landslide hazard identification studies, (2) fault studies, (3) marine geology studies, (4) cooperative studies (under cost-sharing agreements) with local government or other State agencies to identify geologic hazards, and (5) as-needed special investigations of dynamic geologic events and conditions that may have immediate effects on man such as damaging earthquakes or slope failures during storms.

GEOPHYSICS PROGRAM

The Geophysics Program provides specialized earth science expertise for assessing and mitigating volcanic, seismic, and other geologic hazards. This expertise is essential for evaluation of the seismic safety of critical and hazardous facilities and as input for the development of emergency-response plans and the design of earthquake-resistant structures. Specific areas of program activity are (1) earthquake hazard risk assessment, including volcanic hazard monitoring, and (2) strong-motion instrumentation program.

ENVIRONMENTAL GEOLOGY PROGRAM

The Environmental Geology Program provides specialized scientific expertise for dealing with a variety of diverse environmental concerns ranging from the potential of geothermal heat as an alternative energy source in California to mined-land reclamation assistance and review, applied geophysics support for Division programs, and volcanic-hazards response planning. Specific areas of program activity are (1) applied geophysics studies, (2) geothermal resource studies, (3) mined-land reclamation, (4) geochemical studies, and (5) volcanic hazards coordination.

GEOLOGIC INVESTIGATIONS PROGRAM

The Geologic Investigations Program provides both basic and applied geologic information--primarily, but not solely, in the form of maps. This information is used in mineral resource development, in land-use planning and regulation by local government, in timber harvest planning, in development-site evaluation studies, and in other endeavors requiring sound information on the geology of the state. Specific areas of program activity are (1) fault evaluation and zoning, (2) regional geologic mapping, and (3) forest watersheds mapping and timber harvest plan review.

GEOLOGIC INFORMATION PROGRAM

The Geologic Information Program makes information prepared by Division program activities and other pertinent geologic information available to the general public, including local government, the scientific community, and the public at large. The products of Division investigations are edited and graphically prepared for printing. The program also provides technical review of siting reports for certain proposed developments within the state. Specific areas of program activity are (1) information and publications sales, (2) publications production, (3) geology library, and (4) critical-siting report review.

I. Minerals Program

Staff of DMG's Minerals Program conduct geologic investigations of mineral deposits, assess the mineral potential of specific areas, and monitor mining activities. The goal of the program is to help the people of California and the nation meet future mineral needs. The information generated by program activities is published in special reports, mineral commodity reports, maps, open-file reports, and CALIFORNIA GEOLOGY magazine. Specific advice is available through direct consultation with DMG's minerals staff.

DMG minerals studies involve the collection and interpretation of a wide range of specialized and, in some cases, confidential information. Data must be interpreted in light of an understanding of mineralization and other geologic processes. The extreme complexity of California's geology makes this a challenging task. This complexity is largely attributable to the state's position at the edge of the continent where one major plate of the earth's crust converges with another major plate. The slow, ongoing interaction between these tectonic plates has enlarged the continent and resulted in volcanism, the formation of mountain ranges, major displacements of land masses along faults over time (to say nothing of periodic earthquakes), and numerous other dramatic as well as subtle geologic developments that are responsible for the abundance and diversity of mineral occurrences in California.

Indeed, California is one of the nation's leading producers of non-fuel minerals. The agricultural, manufacturing, and construction industries of the state are supplied by numerous mineral commodities produced by the mining industry of California. Approximately $1.9 billion in non-fuel mineral commodities were produced in the state during 1984. California leads the nation in the production of boron, portland cement, diatomite, sand and gravel, and rare earths. It is also a major source of natural gas, liquefied petroleum gases, salt, clay, stone, magnesium compounds, sodium compounds, gypsum, and talc. In addition, California has a wide range of recognized undeveloped mineral resources. These include chromium, cobalt, gold, mercury, nickel, platinum group elements (PGEs), silver, titanium, and zeolites. Some of these are of strategic importance to the nation.

A major goal of DMG's minerals program is to help ensure a continuing supply of minerals of vital importance to the well-being of the state and nation. Many of these mineral resources are relatively abundant, high-bulk, near-surface materials; others are more scarce and unevenly distributed over the earth's surface. As sources for meeting future demands, both types of mineral resources are threatened by urbanization and other land-uses incompatible with mining. The wise management of resource areas can make the needed materials available in adequate quantities long into the future.

The goal of the Surface Mining and Reclamation Act (SMARA) of 1975 is to stimulate the wise use of lands containing important mineral resources while also providing for State assistance in planning for the reclamation of surface-mined lands. The Act authorizes the State Geologist to classify lands according to their mineral potential and to assist local government in the implementation of the State's mined-land reclamation policy. Mineral-land classification involves

the identification of regionally significant deposits of abundant, high-volume, near-surface materials as well as deposits of more scarce mineral materials having regional, statewide, or national significance. Lands containing significant mineral deposits are identified to encourage their preservation from uses incompatible with mining so that the mineral resources will remain available to meet the future needs of society.

1. Mineral resource analysis program

The overall goal of the mineral resource analysis unit is to provide the public, the mineral industry, and government decision-makers with up-to-date information concerning California's mineral industry, mineral economics, and mineral resource potential.

An on-going project carried on by the unit involves maintaining a source of information concerning current mining activities in California. This project uses information obtained from a review of current published and unpublished literature supplemented by visits to active mineral producers and mining operations. Data obtained during mineral industry and mine visits are entered on property report forms and placed in the Division's property report files. Information from these files and production statistics obtained from the U.S. Bureau of Mines are combined each year to produce the California mineral industry report published in CALIFORNIA GEOLOGY. This information also is used in the periodic updates of the DMG special publication, "Mines and Mineral Producers Active in California," and is entered on the Division's master computer index system. The Mineral Property Report forms are also used to answer mineral resource inquiries from government, industry, and the general public.

The Division's annual California mineral industry report for 1983 was published in the October 1984 issue of CALIFORNIA GEOLOGY. The "Mines and Mineral Producers Active in California" for 1983 was completed and published in the Spring of 1984.

A number of studies of individual mineral commodities in a new series of mineral resource commodity reports were completed to review stage by the end of fiscal year 1984-85. These are studies of boron, sodium carbonate, sodium sulfate, calcium chloride, salt, and silica. These reports present timely data on both state and world conditions for the commodity.

A special mineral resource investigation of zeolites in California was completed in 1984-85. The report is the first to cover zeolite occurrences of the state in a fairly comprehensive way.

2. Surface Mining and Reclamation Act

The continued availability of mineral resources that are critical to California's economy and the reclamation of mined lands are the twin and interrelated objectives of the Surface Mining and Reclamation Act of 1975, as amended (SMARA). These objectives are reached through land-use planning and regulatory programs administered by local government. The California Department of Conservation, the Division of Mines and Geology, and the State Mining and Geology Board are responsible for administering the State's role in the SMARA programs.

Three interrelated units within the Division have been established to implement the goals of SMARA. These are the urban mineral land classification unit, the country mineral land classification unit, and the mined land reclamation unit. These units represent a cost-effective means of ensuring that California's mining industry may continue to provide society with needed mineral commodities in an environmentally sensitive manner.

a. Urban mineral-land classification (element of SMARA)

The current objective of urban mineral-land classification ("City SMARA") is the identification of lands that contain suitable and available aggregate materials (sand and gravel, and rock suitable for crushing) to meet future local and regional needs. This objective is achieved through a mineral inventory and economic assessment process termed "classification-designation," which jointly involves the Division and the State Mining and Geology Board. Information on the location of important mineral deposits is developed by the Division through the process of mineral-land classification. This information is evaluated by the Board, whose prerogative it is to designate those resources that are yet available and of economic significance to a region or the state. Local governments receive the classification-designation information, incorporate it in their general plans, and develop mineral resource management policies that will assure the conservation and development of these resources.

Although DMG is involved only in the classification phase of classification-designation, an understanding of designation is needed to understand the role of classification in the overall process.

Designation is a formal action taken by the State Mining and Geology Board. Designaton of an area means that, in the judgment of the Board, the minerals in that area are of prime importance for meeting the future mineral needs of the region or the state. The process apprises local governments of a responsibility in their planning activities to provide not only for their local needs but also for the needs that may be generated well outside their own areas of jurisdiction.

The Board has given first priority to the designation of construction aggregate deposits of Portland-cement-concrete (PCC) grade, in urban and urbanizing areas. The Board's decision to designate particular areas is based on information in mineral land classification reports prepared by DMG, on an environmental assessment of each area, and on input from lead agencies and the public.

As noted above, DMG is responsible for carrying out the classification phase of the classification-designation process. Classification normally entails six distinct but interrelated steps. These classification steps will be explained here in the context of the classification for PCC-grade aggregate.

The first step in the classification process is to determine the boundaries of the production-consumption region under study. The boundaries are drawn along the limits of the marketing area of the active aggregate operations supplying the urban center under study. Included within the production-consumption region boundaries are all areas within the marketing area that have been identified as urbanized or urbanizing.

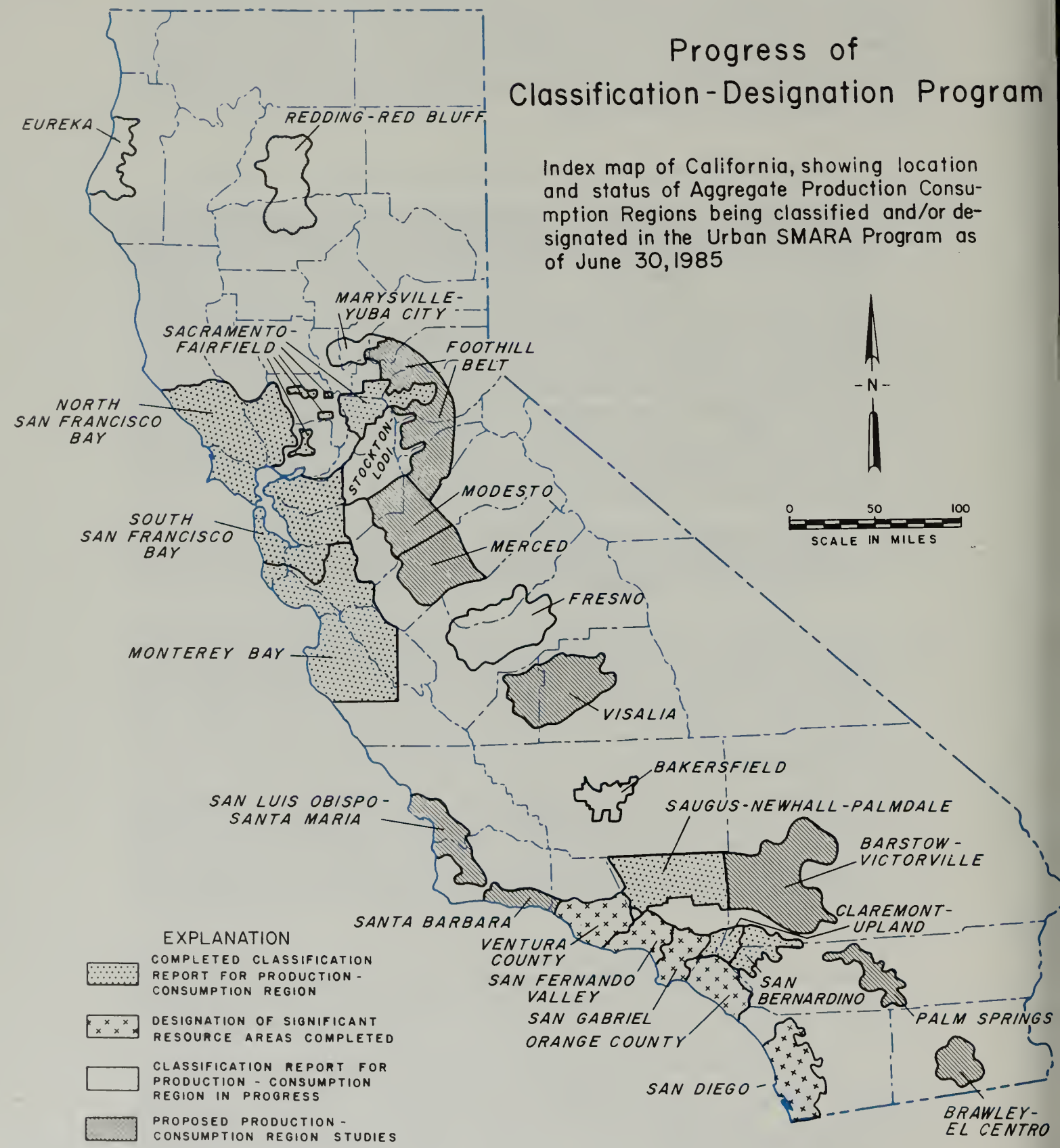


Figure 1. Status of the City SMARA Classification Designation Program, June 30, 1985

In step two, all lands considered to be urbanized or urbanizing are assigned Mineral Resource Zone classifications (MRZ-1--no significant deposits present; MRZ-2--significant deposits present; MRZ-3--insufficient data to determine significance of deposits; MRZ-4--insufficient data to identify deposits) based upon a geologic appraisal of the aggregate resource potential of the land. This appraisal includes study of pertinent geologic reports and maps, field investigation and sampling at outcrops and at active and inactive pits and quarries, and analysis of water-well logs and drill records.

In step three, lands classified as containing significant deposits of PCC-grade aggregate material (areas classified MRZ-2) are evaluated to determine whether or not current uses of these lands preclude possible future mining. Areas currently permitted for mining and areas found to have land uses compatible with possible future mining--based on criteria provided by the Board--are considered available for mining, and are delineated as "sectors"--that is, available aggregate source areas.

In step four, for each sector, total tonnages of PCC-grade aggregate reserves (deposits permitted for mining) and resources (all deposits of PCC quality including the reserves) are calculated based upon field investigation and surface measurement, drill-hole information, waste-material percentages, and deposit densities.

In step five, 50-year needs of the production-consumption region are estimated based upon population growth projections and average annual per capita aggregate consumption rates. Based upon these calculations, the life expectancy of current reserves is estimated, and projected needs are analyzed in relation to current reserves and resources.

Step six involves the identification and characterization of possible alternative sources for PCC-grade aggregate needed to meet the forecast 50-year demand for the production-consumption region.

CLASSIFICATION. Figure 1 shows areas classified or designated, and areas under classification study as of June 30, 1985. During the year the City SMARA program completed the Sacramento-Fairfield and North San Francisco Bay mineral-land classification reports and transmitted the results to the Board for its acceptance.

DESIGNATION. Designations of regionally significant mineral resources have been completed in the San Fernando Valley, Simi Valley, Western Ventura County, Orange County-Temescal Valley, and San Gabriel production-consumption regions (see Figure 1). In 1984-85, the Western San Diego County Production-Consumption Region was designated. For additional information on designation, see the Annual Report of the State Mining and Geology Board.

EIRs. In 1984-85, the DMG mineral land classification staff prepared and completed environmental impact reports for the following production-consumption regions: San Francisco Bay, Saugus-Newhall/Palmdale, and Claremont-Upland/San Bernardino. These documents were prepared in anticipation of Board action to designate certain areas within these regions.

b. Country mineral-land classification (2nd element of SMARA)

The amendment of SMARA in 1980 by the passage of Senate Bill 1300 provided for the mineral-land classification of non-urban areas requested by the State Mining and Geology Board. In the hearings that preceded the passage of SB 1300, it was made clear by the Legislature that mineral-land in non-urban areas subject to land-use threats incompatible with mining was to be classified. The Board in 1982 established that the foothills region of the Sierra Nevada and the California Desert Conservation Area (CDCA) had the number one priorities for the Country SMARA program (Figure 2). These areas are among the most highly mineralized areas and are known to contain mineral deposits of regional and statewide significance.

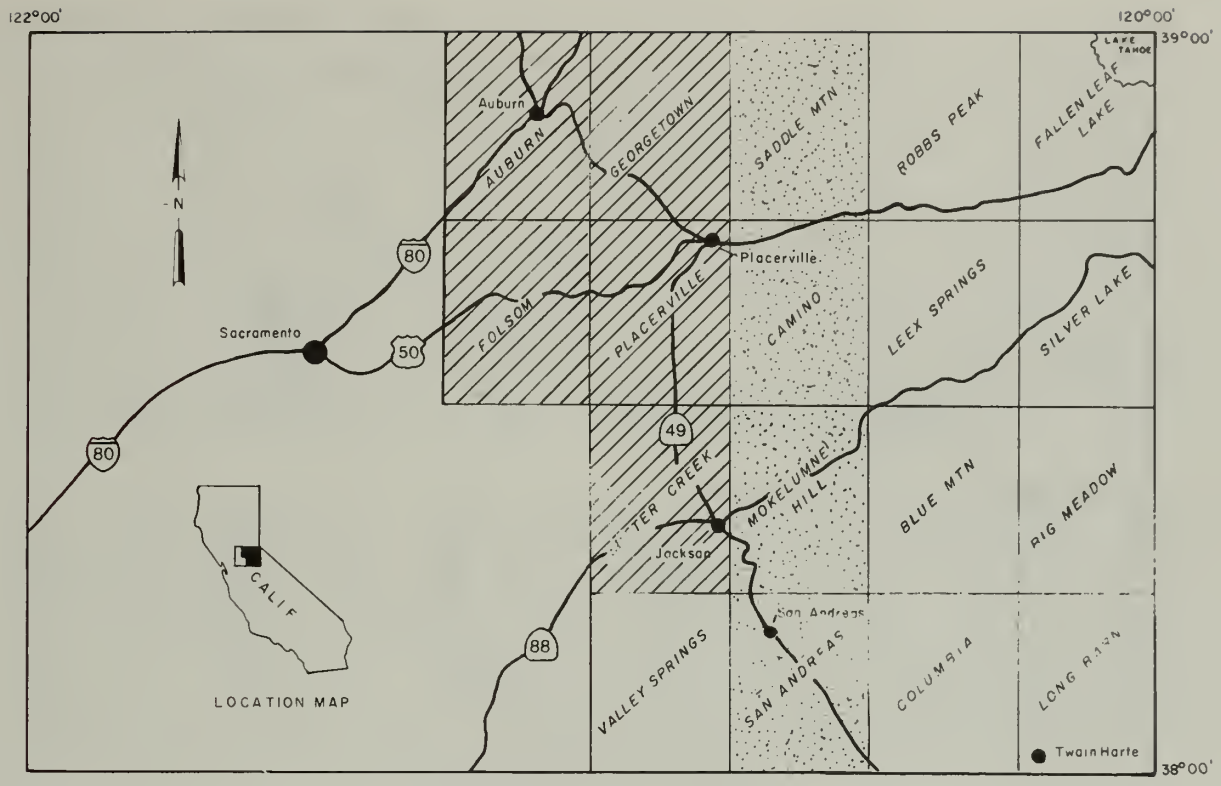
To achieve the mineral-land classification of these areas, each classification project was structured into three phases: (1) assembly and evaluation of existing geologic, geophysical, and mining data pertaining to each 15-minute quadrangle study area; (2) geologic field investigations, mine examinations, and geochemical surveys; and (3) preparation of a geologic report and mineral resource classification map of the area based upon a synthesis and analysis of data gathered during phase I and II of the project.

The area of the Placerville 15-minute quadrangle was chosen as the pilot area in which to begin the country mineral-land classification. During the conduct of the pilot project, special guidelines were established for the classification of non-urban areas. This was during fiscal year 1982-83. The final Placerville report (OFR 83-29 SAC) was released in September 1983. Reports on the Auburn, Folsom, and Halloran Springs quadrangles were released in 1984-85. Figure 2 shows the area of coverage for these studies and the status of the Country SMARA Program at the end of the fiscal year.

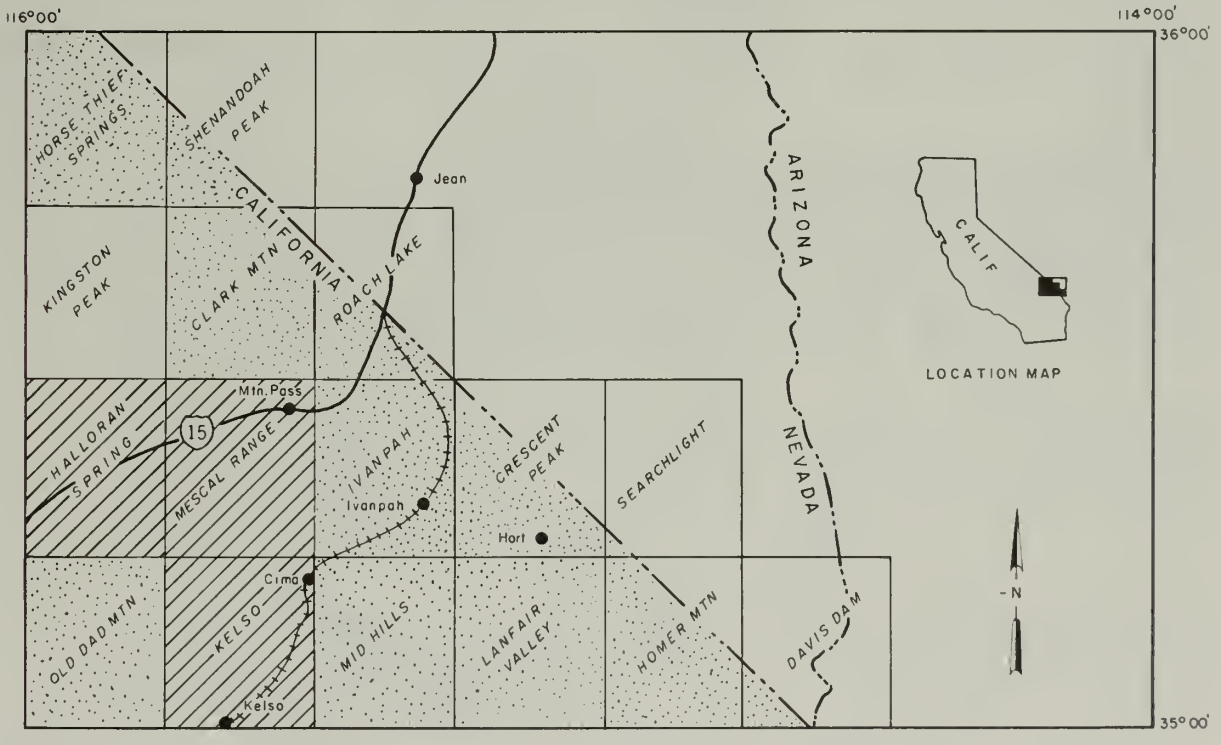
Country SMARA mineral-land classification field activity continued during 1984-85 in the foothills portion of the Sierra Nevada and in the California Desert Conservation Area. Field work and data gathering for the following quadrangles were completed at year's end: Lanfair Valley, Homer Mountains, Ivanpah, Crescent Peak, Horsethief Springs, Shenandoah Peak, Kingston Peak, Clark Mountain, Roach Lake, Mid Hills, Needles, East Death Valley, and San Andreas.

Staff geologists assigned to the program provided information to local governments as well as the mineral exploration community about the scope of the program and the results of these investigations. The classification programs, which represent a departure from the Division's traditional minerals programs, have been effective in identifying outstanding targets for mineral exploration and for alerting local governments to the need to plan for mineral resource conservation.

Petition Classification. When known mineral deposits are subject to imminent threats which would preclude the extraction of those minerals, the owner of the property may petition the State Mining and Geology Board to have the area of the deposit classified on a high priority basis. The petition process has been helpful to the mineral industry and lead agencies confronted with the need to obtain authoritative, unbiased mineral information prior to reaching difficult decisions on controversial land-use issues.



SACRAMENTO 1°X2° MAP AREA

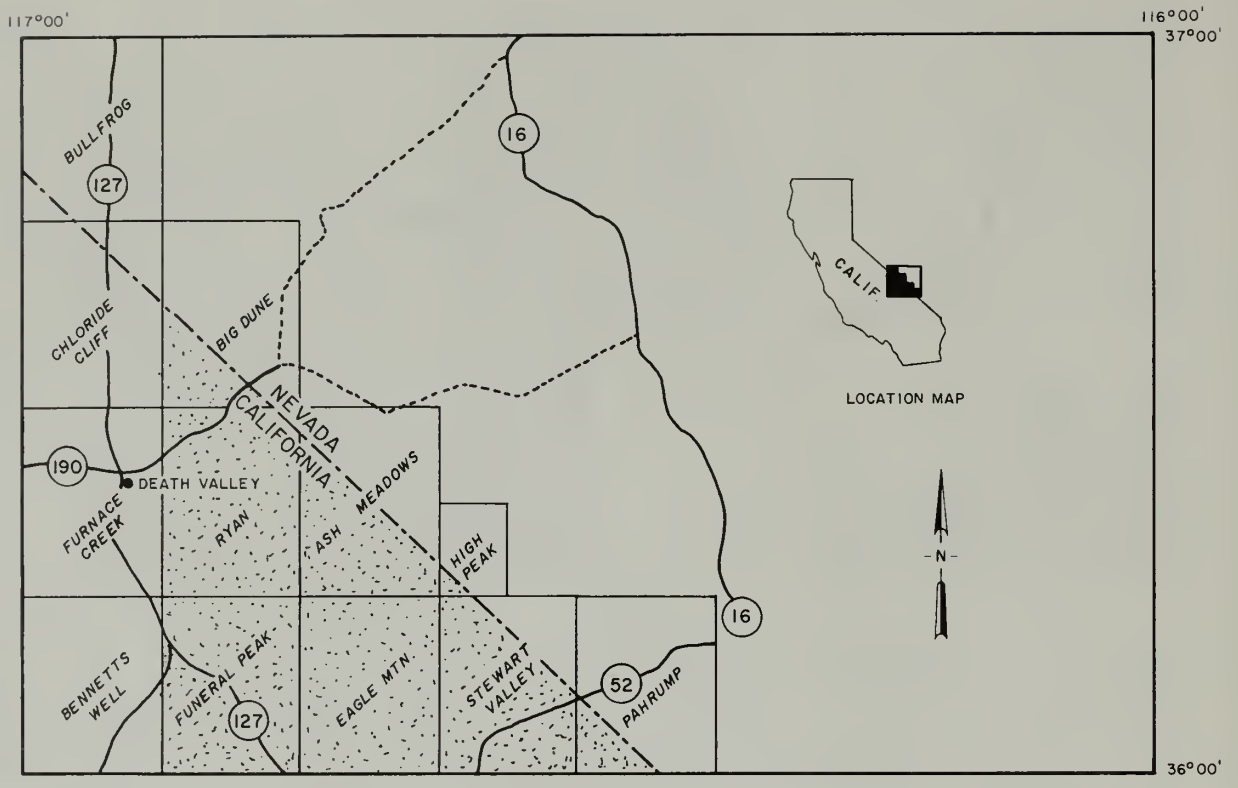


KINGMAN, ARIZONA; NEVADA, CALIFORNIA 1°X 2° MAP AREA

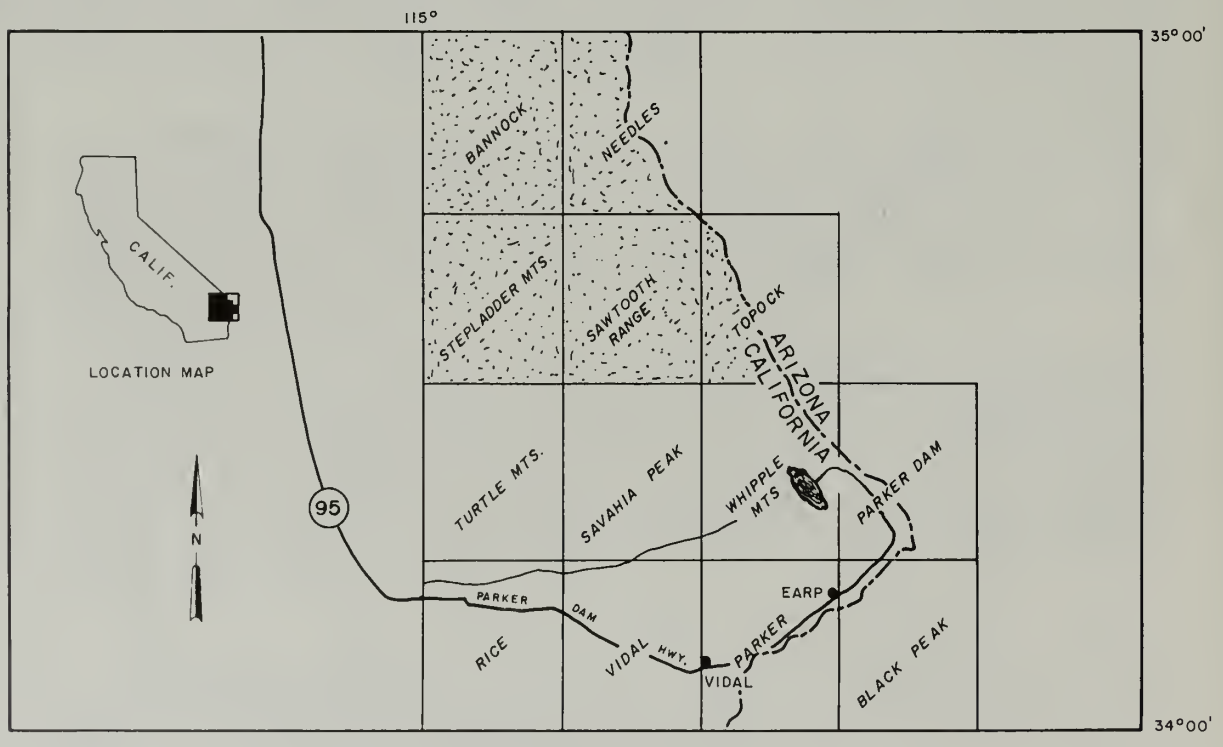
Completed reports, available to the public

Projects in progress

Figure 2. Country SMARA Mineral Land Classification program status, June 1985. Projects completed or in progress.



DEATH VALLEY 1°X2° AREA MAP



NEEDLES 1°X2° AREA MAP

Projects in progress

Figure 2 (Continued). Country SMARA Mineral Land Classification program status, June 1985. Projects completed or in progress.

II. Geologic Hazards Program

The Geologic Hazards Program provides geologic information--in the form of maps and interpretive texts--about geologic hazards in the state. The products present both technical and lay information useful and necessary for public safety purposes. The information is provided in the form of geologic reports and maps resulting from specialized studies of specific hazards. It is best to identify, if possible, potentially hazardous geologic conditions prior to land development. Hazardous geologic conditions need to be recognized so that action can be taken to prevent the property losses, injuries, or even deaths that they might cause. Geologic hazards include landsliding, ground rupturing caused by fault movements, ground shaking caused by earthquakes, tsunamis (seismic sea waves), volcanic eruptions, land subsidence, expansive soils, and the effects of erosion. Knowledge of potential geologic hazards is critical to the land-use planning process.

Activities directly within the Geologic Hazards Program are: (1) landslide studies; (2) fault studies; (3) marine geology studies; (4) cooperative studies (under cost-sharing agreements) with local government or other State agencies to identify geologic hazards; and (5) special emergency investigations of occurrences such as slope failures during storms and earthquake events. Typical products range from county-wide, comprehensive investigations of all geologic hazards present to large-scale quadrangle mapping which emphasizes slope-stability, erosion, faulting, expansible soil, or other conditions that could become hazards to public safety or lead to property damage.

1. Landslide studies

a. Landslide hazard identification program

The landslide hazard identification program, established when Assembly Bill 101 (The Landslide Hazard Identification Act) was signed into law in 1983, was implemented when funds for five geologists were provided for in the State budget for 1984-85. In recognition of the seriousness and widespread nature of the landslide hazard in the state, the Program is charged with developing maps that depict the relative landslide susceptibility of slopes within urban and urbanizing areas of the state.

Prior to the official beginning of the Program on July 2, 1984, workshops were held in Los Angeles and San Francisco to gather input from planners and other representatives of local land agencies who deal with land-use and building permit topics. Also present were geologists from a variety of governmental jurisdictions and geotechnical organizations.

The initial phase of the program involved preparing a list of areas for mapping that fit the criteria specified by AB 101. These candidate areas were evaluated and prioritized and five proposed project areas were selected and approved for mapping by the State Mining and Geology Board.

The project areas and scheduled dates for completion of preliminary maps include: (1) Petaluma "Dairy Belt" (Sonoma County), May 30, 1985; (2) W/2 Newhall Quadrangle (Los Angeles County), May 31, 1985; (3) Danville-San Ramon (Contra Costa County), June 28, 1985; (4) Encinatas Quadrangle (San Diego County), June 28, 1985; and (5) E/2 Val Verde Quadrangle (Los Angeles and Ventura Counties), June 28, 1985.

A series of maps at 1:24,000 scale, prepared for each project area, includes: Plate A- Relative Landslide Susceptibility Map; Plate B- Landslides and Related Features Map; Plate C - Geologic Map; and (in some cases) Plate D- Relative Debris Avalanche Susceptibility Map.

b. Other Landslide studies (Prior to Landslide Hazard Identification Program)

One open-file report resulting from studies of landslides and related slope failures was released during the year. This report, OFR 84-57 LA, "Classification of Landslide Propensity in the Dana Point Quadrangle, Orange County, California," was prepared as part of the program of financial cooperation between the Divison and the U.S. Geological Survey to inventory landslides in selected areas of southern California. This open-file report covers a 20-square mile area and was done to develop a methodology useful for classifying the relative stability of slopes within a selected area and, in particular, to produce a landslide propensity map upon which zones of different degree of slope stability are delineated.

Two other studies of landslides in southern California, also part of the U.S. Geological Survey cooperative program, are nearing completion for open-file reports. These are: a report comparing slope failure and rainfall amounts of the 1983 rains; and an inventory of recent slope failures in the Topanga and Canoga Park quadrangles in Los Angeles County.

Two additional studies of landslides in southern California are in publication processing for publication as special reports: a detailed report on 1978 and 1980 slope failures in southern California and a report on "Areal Geology, Ancient Landslides, and Recent Slope Failures of the North-Central Coastal area, San Diego County, California."

2. Fault studies

Fault mechanism studies underway during the period of this report include work on the San Andreas fault, the San Gabriel fault, the Hayward fault, and faults in San Diego and Imperial counties. Preparation of a comprehensive summary of nearly ten years of Division mapping and study of the San Andreas fault in Los Angeles County was completed. This report, OFR 85-10 LA, "Earthquake Hazards and Tectonic History of the San Andreas Fault Zone, Los Angeles County, California," includes a text, eight large-scale geologic maps, and 11 annotated fault maps, with cross sections and explanatory data. Additional work was done on a continuing study of the general characteristics, recency of movement, and potential for future activity of the San Gabriel fault zone. Field work to study soil development and displacement along the Hayward fault was initiated. Information on the San Diego-Oceanside to Salton Sea-El Centro area,

including analyses of aerial photos and compilation of data emphasizing fault activity and Quaternary tectonics, which was developed during a study initiated in the 1982-83 reporting period, was used to upgrade and modify a geologic map of the area that was being compiled. The map was released as OFR 84-59 LA, "Preliminary Geologic Map of the California-Baja California Border." This year field checking of faults and suspected fault features visible on aerial photos was well underway in selected areas north of the U.S.-Mexico border.

A study entitled "The Rose Canyon Fault Zone--a Review and Analysis" was completed for the Federal Emergency Management Agency (FEMA) under a cooperative financial agreement. The purpose of the study was to provide the basis for an evaluation of the risk and possible level of damage in the San Diego area associated with seismic activity on this fault system. Based on a comprehensive review of published and unpublished data, a range of "maximum credible" and "maximum expectable" earthquake magnitudes was presented using two different fault models and several methods of estimating potential earthquke magnitude. Recommendations were made for further investigation of the fault zone. Minor revisions are being made prior to release of this study as an open-file report.

3. Marine geology studies

The Division's marine geologist is conducting a major synthesis of offshore California geology. This fiscal year was the fifth year of his work preparing a geologic synthesis of the California continental margin. The resulting maps depict bedrock and surficial geology as well as character and recency of faulting, landslides, sediment creep, sediment conduits, Bouguer gravity anomalies, magnetic anomalies, earthquake epicenters, selected focal mechanisms, data sources, oil and gas well locations, and geophysical track lines. They are being compiled at a scale of 1:250,000 on NOS bathymetric bases. The first three of seven of these maps are in press. The maps will be accompanied by a comprehensive bibliography of geological and geophysical studies conducted within this area as well as by an explanation of symbology, developed largely during this study, that uses example seismic data as a reference for the user. The first part of the study to be released (areas one, two, and three of seven) includes the southern California continental margin from Mexico to Palos Verdes and from the shoreline to the Patton Escarpment. Areas four, five, six, and seven (of seven) cover offshore areas of central and northern California, and are currently being prepared for publication.

The Division's marine geologist is also currently involved in the interpretation of high resolution data and processing for selected areas of the California continental margin where detailed information is necessary to shed light upon specific questions that have arisen from our regional geologic synthesis.

The offshore California geologic synthesis is being conducted by the Division as a cooperatively funded project between the Coastal Commission, the U.S. Geological Survey, and the Department of Conservation's Division of Mines and Geology. In addition, grant funding from the University of Texas, Austin, has helped in completing this project in a timely way.

Marine geology studies underway during fiscal year 1984-85 included:

1. Geologic synthesis of the southern California continental margin;
2. Earthquake related hazards in the offshore Los Angeles basin (in press);
3. Structural transect, Salton Trough to Patton Escarpment;
4. Open-file report of DSV ALVIN observations; and
5. Publication processing of southern California continental margin geologic maps series (areas one, two, and three of seven).
6. Initial studies of hard mineral occurrences offshore of California.

4. Cooperative studies with other government agencies

The Division conducts a number of geological studies in cooperation with local government and other State agencies to provide needed technical information about areas of actual or potential geologic hazard. Cooperative activities are funded jointly by the Division and the cooperating agency under various arrangements, the nature of which depends upon the availability of funds and personnel, the relative urgency of the project to the State and to the cooperating agencies, and other factors. Cooperative activities with counties were either suspended or reduced owing to the changed budgetary conditions of both counties and the State after July 1, 1978.

a. Los Angeles County

Cooperative funding by the Los Angeles County Flood Control District terminated at the close of the 1983-84 fiscal year as planned. However, work continued to complete the Division's geologic studies in Los Angeles County initiated under previous funding arrangements with the County of Los Angeles, Department of County Engineer, and with the Los Angeles County Flood Control District. One open-file report was released: OFR 84-49 LA, "Geology of the Northeast Quarter of the Newhall Quadrangle, Los Angeles County, California." A report on part of the Pasadena quadrangle was revised and nearly completed for open-file release. Field mapping was completed in the north half of the Mint Canyon quadrangle, and recessed in the southeast quarter of the Newhall quadrangle. The final phase (report preparation) of a multi-year study of the San Andreas fault zone along the northern portion of Los Angeles County was completed. In previous years, this study was partly funded by the County of Los Angeles, Department of County Engineer and the U.S. Geological Survey.

b. Orange County

Work continued, on a reduced basis, on projects initiated and well-advanced under previous cooperative funding arrangements with Orange County. Two open-file reports were released during the year: OFR 84-58 LA, "Engineering Geology of Part of the Western Half of the Santiago Peak quadrangle, Orange County, California" and OFR 81-10 LA, "Classification and Mapping of Quaternary Sedimentary Deposits for Purposes of Seismic Zonation, South-Coastal Los Angeles Basin, Orange County, California." This

report is on an investigation (done also in cooperation with the U.S. Geological Survey) of the ground response from seismically induced shaking in a portion of Orange County.

c. California Coastal Commission (see Marine Geology Studies, page 13)

5. Special investigations

Division geologists respond as needed to evaluate the hazard potential of ongoing geologic events. These evaluations are made on the Divison's initiative, or at the request of the State Office of Emergency Services or local government. Examples of such investigations during 1984-85 include the Lower Rock Creek series of earthquakes of November 23-26, 1985, where ground rupture had been reported near Pleasant Valley Reservoir (shown to be incorrect by field examination) and several meetings held to review data and status of problem areas. One such meeting concerned the "Fairfax-Wilshire gas incursion" that occurred on March 24, 1985, in the city of Los Angeles. The Division continues to participate on the Geologic technical Committee assembled by the city.

III. Geophysics Program

The goal of the Geophysics Program is to increase the safety and welfare of the public by reducing the damaging consequences of earthquakes. The program provides specialized earth science expertise that is essential for evaluation of the seismic safety of critical and hazardous facilities and as input for the development of emergency-response plans and the design of earthquake resistant structures. Specific areas of program activity are (1) earthquake hazard and risk assessment and (2) strong-motion instrumentation data collection.

1. Earthquake hazard and risk assessment

To help minimize the costly toll of earthquakes in California, the Earthquake Hazard and Risk Assessment Program evaluates the earthquake threat for different regions of the state and characterizes the damage to critical lifelines likely to result from an occurrence of the worst-case earthquakes for active faults in each region. These projections are based upon an understanding of the region's geology, analysis of the historic and geologic record of the region's earthquakes, and engineering assessments of the vulnerabilities of lifeline structures to strong shaking and other earthquake phenomena. The published information is used, perhaps most importantly, by local governments in making land-use decisions, in developing effective regional and local emergency-response plans, and in providing the public with earthquake-hazard education. Program staff also provide technical advice on the safety of critical and hazardous facilities and, during periods of heightened volcanic or seismic hazard, coordinate and participate in hazard assessment activites and emergency-response planning with Federal and local government agencies as well as other State agencies.

a. Damage scenarios

The devastating impact of an earthquake on existing urban centers can be reduced by effective emergency-response planning. Post-disaster operations such as search and rescue and restoration of lifelines require an understanding of the anticipated geographic distribution of damage and casualties, as well as performance of specific lifelines.

An earthquake damage scenario characterizes the probable impacts of a credible, worst-case earthquake originating from a particular geologic fault. When a fault is known to have produced a major historical earthquake--as is the case, for example, with the northern San Andreas fault, which produced the 1906 San Francisco earthquake--the historical earthquake is used as the scenario event. Once the scenario earthquake is defined (epicenter, magnitude, amount and nature of fault movement), the next step is to map the areal distribution of damaging levels of ground shaking and of other damaging earthquake phenomena. Based on this map and an understanding of the special vulnerabilities of the region's major lifelines, maps are prepared that show the performance of major highways and airports, railroads and marine facilities, communications networks, water supply and waste disposal facilities, electrical power facilities, natural gas and petroleum facilities, and schools and hospitals. The maps show the post-earthquake operational

status of these lifelines upon which recovery operations will depend. The damage scenarios thus provide information that will enable communities in the region at risk to make realistic preparations and to plan effective emergency-response and post-disaster strategies. The damage scenarios are also useful in land-use planning and for targeting areas for the implementation of hazardous-building abatement programs.

Two damage scenarios have been published and are available. One is the "Earthquake Planning Scenario for a M 8.3 Earthquake on the San Andreas Fault in the San Francisco Bay Area" (DMG Special Publication 61). The other is the "Earthquake Planning Scenario for a M 8.3 Earthquake on the San Andreas Fault in Southern California" (DMG Special Publication 60).

During fiscal year 1984-85, Program staff completed the review copy of a damage scenario of major lifelines in the San Francisco Bay region for a magnitude 7.5 earthquake on the Hayward fault. This earthquake damage scenario is planned for publication during fiscal year 1985-86.

b. Seismic hazard maps

Loss of life and property due to earthquakes affecting future urban developments can be reduced by effective land-use planning; that is, by reducing exposure to seismic hazards through appropriate siting and design of structures. Although land-use decision practices have incorporated fault rupture hazards since 1972, ground shaking hazard is considered primarily for critical facilities. For example, State highway structures are designed to withstand the maximum level of earthquake shaking expected for a region.

During fiscal year 1984-85, Program staff have nearly completed an update and revision of DMG Map sheet 23, "Maximum Credible Rock Acceleration in California," which is used by the California Department of Transportation in the design of transportation facilities statewide. This map portrays the geographic distribution of ground shaking, considering the largest earthquakes expected from all potential earthquake sources throughout the state. Since the first publication of this map in 1974, new information has been obtained on the location and earthquake-generating potential of faults, as well as on the development of strong ground shaking as earthquake generated waves pass through the earth to various locations throughout the state. These new insights are the basis for revising this important publication.

c. Seismic monitoring

Portable seismographic recorders are used in studies of aftershocks following damaging earthquakes and in the monitoring of seismicity during periods of heightened concern about a possible imminent earthquake or volcanic eruption. Earthquake aftershocks are monitored as a means of gaining a better understanding of the fault that produced the earthquake and in order to determine the relation between local ground conditions and the distribution of earthquake shaking and damage during the earthquake.

In an effort to continue development of a means to map expected strong ground motion prior to a damaging earthquake, DMG entered a joint project with Lawrence Livermore National Laboratory to test a method of estimating the effects of near surface geology on ground motion. Weak motion from moderate-sized regional and small local earthquakes were recorded on soil and rock sites in the Coalinga region. These data were compared and used to identify areas of intensified shaking. The results will be compared with actual recordings of strong ground motion during the 1983 Coalinga earthquake. If successful, the method will eventually provide a means of incorporating knowledge of earthquake-shaking potential into land-use decisions.

Four permanent seismographic recorders are maintained for public display in the Sacramento area, one in the State Capitol, and three in the Division's regional office. The recorders have been popular exhibits since their installation, and enable the Division staff, the public, and legislative personnel to be aware of California earthquakes as they happen. During fiscal year 1984-85, DMG staff installed a computer-controlled electronic message board adjacent to the seismograph recorder in the State Capitol. This sign greatly improves information to the staff and visitors of the Capitol about significant earthquakes affecting California.

Timely seismological data is also supplied to the Division by the Seismological Laboratory at Cal Tech and the Seismographic Stations of U.C. Berkeley. These networks provide timely information on all earthquakes of Richter magnitude 4 or greater. Further information on seismicity in California is provided by the U.S. Geological Survey through a data-exchange agreement.

d. Volcanic hazards monitoring

Continued concern by scientists and the public for the possibility of volcanic activity in the Mammoth Lakes region has brought legislated responsibility to DMG for monitoring and assessing volcanic hazard potential to ensure public safety. During fiscal year 1984-85 the Division conpleted, tested, and began normal operation of an automated seismic data analysis system that monitors seismic data signals that come from the Long Valley caldera over the State microwave network. DMG's automated seismic data analysis system detects, locates, and analyzes earthquake signals in near-real time, and notifies key staff scientists by telephone 24 hours a day when unusual seismic activity or a system malfunction occurs. The system enables the Division to provide timely warning or advice on the imminence of a volcanic eruption to the State Office of Emergency Services and Federal, local, and other State agencies. This program is complemented by the volcanic hazards response planning functions of the Environmental Geology Program (page 29).

e. Southern California Seismic Project

The Southern California Seismic Project, formerly called the Cal-Mexico Project, was undertaken to identify and integrate understanding of seismic hazards on the California side of the California-Mexico border. Through this program, the Division is playing a lead role in a collaborative effort involving scientists and technicians of both countries. The purpose of this collaboration is the collection and interpretation of geological, geophysical, and seismological data for the purpose of delineating, describing, predicting, and mitigating seismically related geologic hazards in the border region.

During fiscal year 1984-85, the program produced, with assistance from the Federal Emergency Management Agency (FEMA), two seismic hazards maps that show seismic shaking intensities and areas susceptible to liquifaction during strong ground shaking for a hypothetical magnitude 6.9 event on the Rose Canyon fault and a hypothetical magnitude 7.1 event on the Coronado Bank fault. These maps are intended for use by emergency response planners. Also during 1984-85, a preliminary regional geologic map was released. The map covers the area of California and Baja California Norte within about 60 miles of the international border.

Staffs of DMG and U.C. San Diego responded to an unusual earthquake swarm that occurred in June 1985 a few miles offshore from San Diego. Several portable seismographs were deployed. Data from these instruments will be analyzed to determine the causitive fault so that its earthquake potential can be appropriately considered in future hazard mitigation efforts in the San Diego area.

During 1985-86, the program will continue its analysis of the regional seismic hazards as a participant in the binational border area earthquake preparedness planning program organized on the U.S. side by FEMA.

f. Advisory Services

Reviews relating to seismology are required to assess the adequacy of seismological data in documents for planning and design considerations of various public projects. These reviews are done by geologists and geophysicists using the most current information and state-of-the-art techniques. In fiscal year 1984-85 Program staff reviewed the seismic safety aspects of environmental impact reports and hospital safety reports required by the Hospital Safety Act (SB 519). Other important reviews included seismic safety issues associated with the Diablo Canyon nuclear power plant and a proposed State prison near Avenal in Fresno County.

2. Strong-motion instrumentation program

The Strong-Motion Instrumentation Program (SMIP) was created to provide information on the force of ground motion and the deformation induced in structures by earthquake-generated ground motion in California. This information is critical to the efforts of engineers trying to design earthquake-resistant structures. SMIP was established after the San Fernando earthquake in 1971, when Chapter 8 of Division 2 of the Public Resources Code (SB 1374) was signed into law. The Department of Conservation's Division of Mines and Geology was designated as the responsible managing agency.

SMIP is installing, maintaining, and monitoring a network of strong-motion instruments to study the nature of strong earthquake motion and to collect, process, and disseminate data for application to the design of earthquake-resistant structures. This activity is supported by a special fund derived from a fee applied to construction permits issued by cities and counties. The objective of the strong-motion program is to obtain statewide detailed records of the response of rock and soil units and of engineered structures to strong shaking caused by earthquakes. The accelerograph, an instrument that measures the forces generated by seismic waves, is used to record these data.

The sites instrumented by SMIP are selected with the advice and assistance of the Strong Motion Instrumentation Committee of the Seismic Safety Commission. The Committee encourages a variety of individuals, organizations, and agencies to nominate sites and structures for instrumentation. Ultimately, the State strong-motion instrument network will include about 400 buildings, 30 dams, 40 transportation structures, 25 lifeline facilities, 400 isolated ground response sites, and 20 special arrays.

During the fiscal year 1984-85 the Strong Motion Instrumentation Program completed its thirteenth year of operation. SMIP activities are conducted out of offices in Sacramento and San Bernardino. During the thirteen years of operation, a total of 306 ground response stations have been installed. In addition, 74 buildings, 22 dams, five transportation structures, and one power generating plant have been instrumented. In total, the 427 stations contain nearly 2,450 seismic data sensors; the statewide distribution of these stations is shown on the map in Figure 4.

Strong motion instrument installation activity during 1984-85 included the installation of six ground response stations and the instrumentation of ten buildings. As indicated by Table 1 and shown on the map in Figure 3, the facilities instrumented are located throughout the state, in small cities as well as large urban areas. The 16 stations required the installation of 150 sensors and represent a corresponding increase in the maintenance effort.

The installation of strong motion recorders in structures and at ground-response stations has begun to provide important and instructive data on the principal characteristics of strong earthquake shaking. As one example, Figure 4 shows the strong motion data recorded at a county administration building in San Jose during the Morgan Hill earthquake of April 24, 1984. The figure illustrates the increased shaking which occurred at the roof and upper floors of the building compared to that at the lower levels. Data such as these are invaluable for guiding seismic retrofit efforts and improving seismic design codes and construction practice.

Most of the strong-motion data processed this year were generated by the Morgan Hill earthquake of April 24, 1984. Nearly 50 accelerograms were recovered by SMIP following that earthquake; almost half were obtained in extensively-instrumented structures ranging from a one-story warehouse in Hollister to a 12-story government office building in San Jose. The Morgan Hill records provide rich data for earthquake engineers and seismologists.

Table 1. Facilities instrumented by SMIP during 1984-85.

Station	County	Description	Sensors
Concord Heritage Apartments	Contra Costa	8-story masonry apartment building	13
Eureka Salvation Army Silvercrest Apartments	Humboldt	5-story masonry apartment building	13
Fortuna Safeway Foods	Humboldt	Ground-response station	3
Hayward CSUH Science Building	Alameda	4-story concrete classroom/laboratory building	16
Indio Riverside County Administration Building	Riverside	4-story concrete office building	10
Morgan Hill Coyote Lake Dam Downstream	Santa Clara	Ground-response station	3
Oakland 1200 Lakeshore Drive	Alameda	25-story concrete apartment building	16
Palo Alto Ford Aerospace Building	Santa Clara	5-story concrete office building	16
Palo Alto Ford Aerospace Grounds	Santa Clara	Ground-response station	3
Poway City government complex	San Diego	Ground-response station	3
Rancho Cucamonga* San Bernardino County Law & Justice Building	San Bernardino	4-story base-isolated courthouse building	6
Redlands Redlands Federal Savings	San Bernardino	6-story steel-frame bank building	13
San Francisco Hong Kong Bank	San Francisco	17-story steel-frame bank/office building	13
Santa Rosa Bethlehem Tower Apartment Building	Sonoma	14-story concrete apartment building	16
Santa Rosa Bethlehem Tower Grounds	Sonoma	Ground-response station	3
Tehachapi CDF Fire Station	Kern	Ground-response station	3

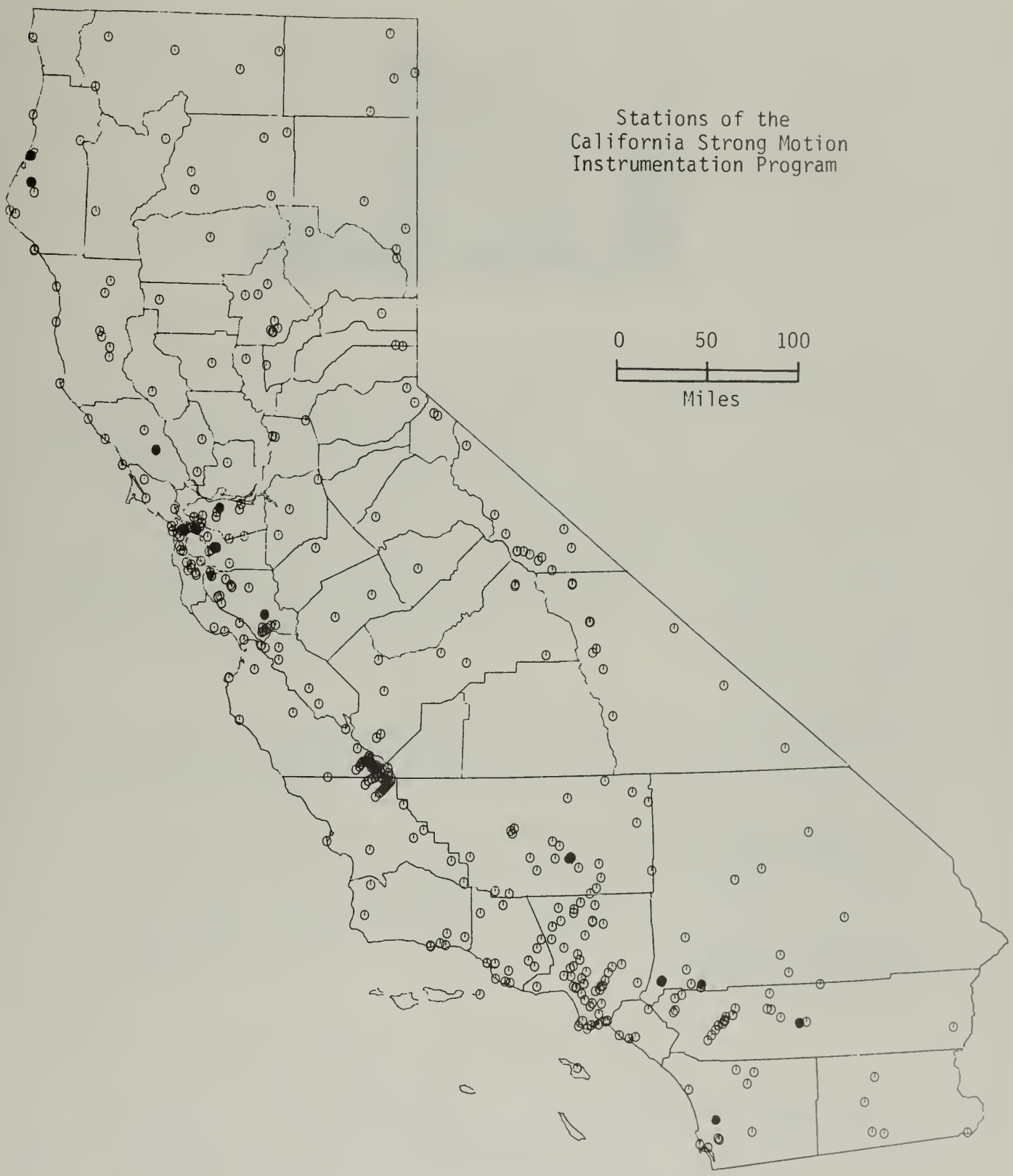


Figure 3. Stations of the California Strong Motion Instrumentation Program are located throughout the state. The solid symbols indicate stations installed during fiscal year 1984-85.

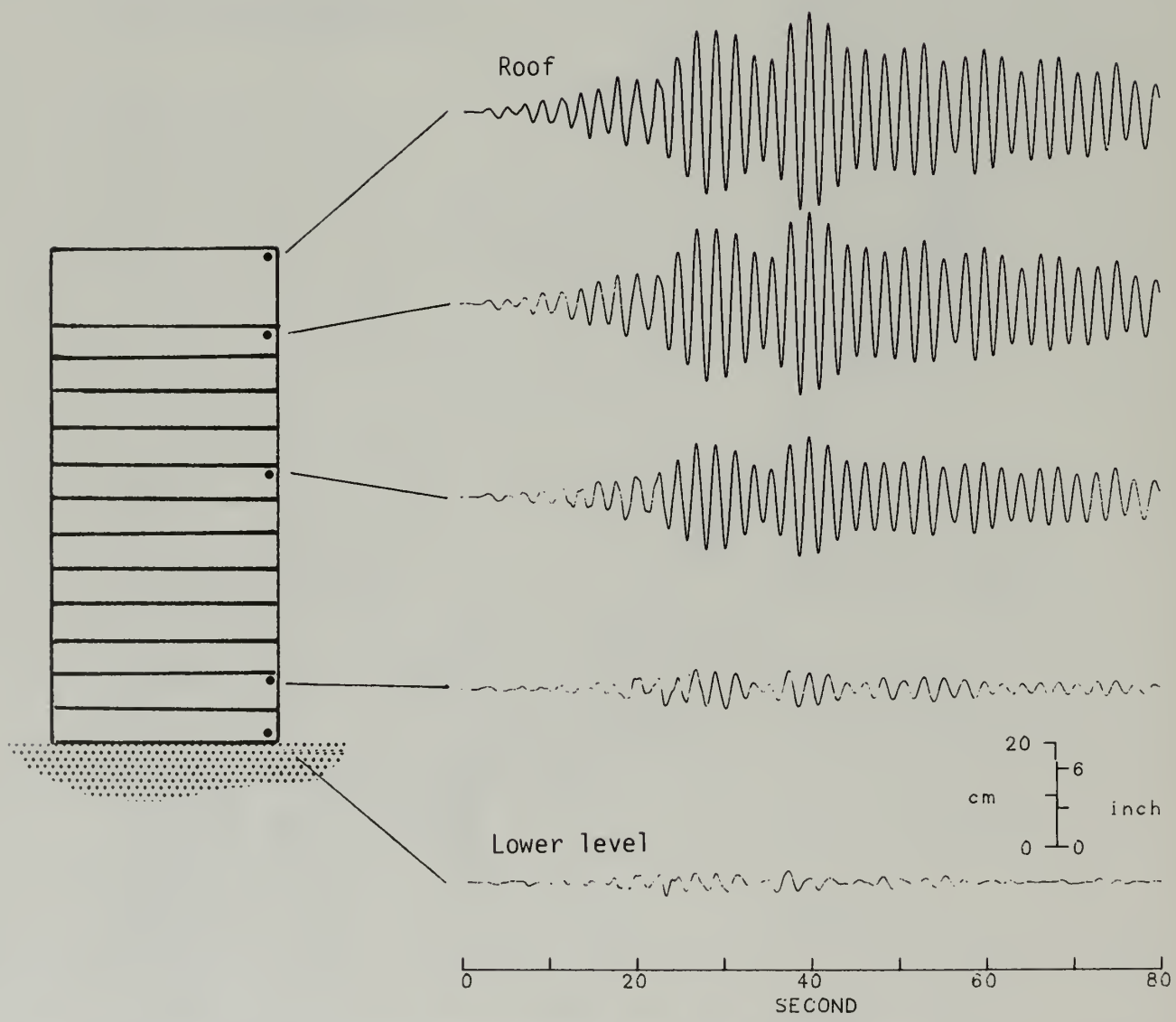


Figure 4. Strong-motion records obtained in the Santa Clara County Administrative Building in San Jose during the Morgan Hill, California earthquake of April 24, 1985. These records show that the upper floors shook more strongly and for a longer time than the ground floor.

IV. Environmental Geology Program

The Environmental Geology Program provides specialized scientific expertise for dealing with a variety of diverse environmental concerns ranging from the potential of geothermal heat as an alternative energy source in Californa to mined-land reclamation assistance and review, applied geophysics support for Division programs, and volcanic-hazard response and planning activities. Specific areas of program activity are (1) applied geophysics studies, (2) geothermal resource studies, (3) mined-land reclamation, (4) geochemical studies, and (5) volcanic hazards response planning.

1. Geophysical studies

The Division's applied geophysics unit provides geophysical support services for other Division programs including geothermal and mineral programs. In addition, the applied geophysics unit carries out independent projects such as compilation of gravity and magnetic maps.

Most of the geophysical surveys conducted by DMG in fiscal year 1984-85 were in support of the geothermal and SMARA programs. Other surveys were primarily basic geophysical studies. The geophysical data resulting from these studies are used principally to define fault zones and other geologic structures, to determine local bedrock depths, and to locate certain types of rocks, mineral deposits, and geothermal resources, or areas favorable for such resources.

a. Gravity mapping

Activity continued on the State Gravity Map project. The Sacramento 1° x 2° quadrangle was printed this year, and both the San Bernardino and revised Santa Rosa 1° x 2° quadrangles are essentially ready for printing. The last sheet of the series, the Santa Ana sheet, is also very nearly complete.

An Isostatic Residual Gravity Map (scale, 1:750,000), which covers the entire state, has been submitted to us by the U.S. Geological Survey for possible publication in the California Geologic Data Map Series. This map represents a substantial investment of time and effort by DMG because it utilizes much data originally obtained by the Division. Possible means of financing the publication of the map are being discussed with the U.S. Geological Survey.

b. Aeromagnetic mapping

Preparation of the 1:250,000 scale aeromagnetic map series is continuing. The Weed, Santa Rosa, Sacramento, Alturas and Needles sheets have been completed, and the San Bernardino sheet is nearly so. The San Francisco-San Jose and Trona-Kingman sheets are in preparation. The completion of most of the remaining map sheets will depend on the progress of aeromagnetic surveys in the state.

An aeromagnetic map of the Cascades region in California submitted to DMG by Oregon State University is being prepared for publication in the Regional Geologic Map Series. This map should be particularly useful in studies of geothermal resources of the region.

c. Geophysical projects to support other investigations

Geophysical field and office support for several geothermal and mineral investigations was provided in the form of magnetic, gravity, and electrical resistivity surveys and data analyses. The geophysical surveys provided information pertinent to the identification of buried faults and other geologic structures, variations in the thickness of subsurface strata, the identification of certain types of rocks in the subsurface, and the magnetic properties, electrical resistivities, and densities of local rock units.

Geothermal studies supported include a Department of Energy joint project with the University of Nevada in eastern California and western Nevada near Mono Lake and Long Valley. The state-funded Sonoma Valley geothermal assessment study was completed in the previous fiscal year, but the report was finished during the current year.

Mineral projects supported include the SMARA mineral land classification of the Camino Quadrangle in the Sierra Nevada Foothills, and a number of SMARA quadrnagles in the Kingman and Needles sheets in the Mojave Desert.

An article summarizing DMG's geophysical studies for geothermal projects in the Santa Rosa-Sonoma area was also written and submitted to California Geology late this year.

2. Geothermal resource studies

The Division's geothermal resources unit provides the special information and expertise needed to evaluate the potential of specific areas in California for the development of geothermal energy. During fiscal year 1984-85, with funding from the U.S. Department of Energy (DOE), DMG completed assessment studies in an area including eastern California and western Nevada, near Mono Lake and Long Valley, in a joint effort with a team from the University of Nevada (the California-Nevada project). In addition, a report on DMG's State-funded, third-year geothermal resource assessment study was finalized and released during this fiscal year.

a. California-Nevada project

The program staff performed assessment studies for the DOE-funded California-Nevada project in eastern California and western Nevada in cooperation with the staff of the University of Nevada (Las Vegas). The project area extends from the vicinity of Aurora, Nevada and Fales Hot Springs, California on the north to Long Valley, California on the south. Although Long Valley was in the project area, the main thrust of the current

study was in the area north of Long Valley. The project area is the site of much relatively young volcanic activity; it includes two major known calderas: one at Long Valley and the other near Fales Hot Springs (Little Walker caldera). A number of hot springs are also known to be present in the area.

According to the joint agreement, each state team was responsible for certain parts of the overall California-Nevada study. Each state team compiled and checked geologic mapping within its respective state boundaries. These maps were then combined to produce the final geologic map. Other parts of the study were done completely separately. For example, geophysical surveys were the responsibility of the California team, and most of the geochemical work was the responsibility of the Nevada team.

The final report includes portions written by each team. The assessment of the geothermal potential of the area was completed as a joint effort, after all data had been reviewed. A draft of the report is scheduled to be completed by June 30, 1985.

b. Sonoma Valley Assessment

In 1981-82 and 1982-83 Program staff performed detailed assessment studies in Sonoma Valley, first in the southern part under DOE funding, and then in the northern reaches of the valley under State funding. In 1983-84, under State funding, a final "wrap up" study that included data developed in both of the earlier studies, as well as data from new shallow temperature drilling, was completed to provide the potential user with a comprehensive assessment of the geothermal resources for the entire Sonoma Valley area.

DMG chose the Sonoma Valley for study because it is characterized by: (1) a moderately widespread occurrence of geothermal resource indicators; (2) proximity to a large labor force and to agricultural and industrial market places (Santa Rosa and the San Francisco Bay area); (3) good transporation facilities; and (4) interest in geothermal resource development on the part of local government and the private sector.

The studies included extensive sampling and temperature probes of geothermal wells; resistivity, seismic refraction, magnetic, and gravity surveys; geohydrology and geochemistry studies; and reconnaissance geologic mapping. Also included was a study of the area's seismicity as it relates to geothermal occurrences and an extensive shallow temperature survey that involved drilling and testing of over 150 holes up to 6 feet deep in the most promising geothermal areas of the valley.

In 1984-85, a major final report that includes and combines all of the important data developed in DMG's previous and current year studies was finalized and released as OFR 84-29 SAC, "Geothermal Resources Investigations of the Sonoma Valley Area, Sonoma and Napa Counties, California."

3. Mined-land reclamation (3rd element of SMARA)

The Mined Land Reclamation Program is, along with the Urban Mineral Land Classification Program (see page 5) and the Country Mineral Land Classification Program (see page 8), one of the three equally important programs established in the Division of Mines and Geology to fulfill the mandates of the Surface Mining and Reclamation Act (SMARA) of 1975. Under SMARA, the reclamation of mineral lands is to be accomplished under the policies and regulations developed by the State Mining and Geology Board (SMGB). Local governments, known as lead agencies, have the responsibility to develop and administer ordinances conforming to the SMGB requirements under the land-use permit process. Reclamation plans are required to be approved by counties or municipalities as part of the procedures. The reclamation plans are prepared by the mine operator and submitted to the lead agency for approval.

The Division of Mines and Geology, through its Mined Land Reclamation Program, provides both lead agencies and mine operators with technical assistance for the preparation, regulatory review, and implementation of reclamation plans.

The requirements for a complete reclamation plan are presented in Article 5, Sections 2770 through 2779 of SMARA, and in the California Administrative Code (CAC), Title 14, Chapter 8, Subchapter 1, Article 1, Sections 3500 through 3505. Section 2774(c) of SMARA states that "on request of a lead agency, the State Geologist shall furnish technical assistance in the review of the reclamation plans."

During fiscal year 1984-85, the Mined Land Reclamation Program accomplished the following:

- Program staff reviewed 50 reclamation plans and provided procedural guidance to a variety of lead agencies.

- A successful three-day conference was held in September 1984 entitled "Productive Second Uses of Mined Lands" (jointly sponsored by the California Department of Conservation, the State Mining and Geology Board, and the Institute for the Human Environment). The conference allowed mining company representatives, government decision-makers, land developers, and conservation interests to discuss productive second uses of surface-mined land. Proceedings from the conference are being published and will be available from the Department of Conservation.

- Portions of a mined-land reclamation planning publication entitled "Surface Mined Land Reclamation Planning and Implementation in California" were completed in preliminary draft form. The typescript contains chapters on planning, subsequent uses of mined land, land shaping, ground and surface water management, erosion and sediment control, and revegetation, as well as an annotated bibliography and a glossary. Chapters were sent out for review. Completion of the draft for publication is pending.

4. Volcanic hazards response planning

The objective of the Volcanic Hazards Response Planning Unit is to provide advice on the current state of volcanic hazards in California by studying potential eruption areas and by maintaining liaison with other scientific experts and agencies involved in such studies. This unit operates closely with the Office of Emergency Services (OES), through the State Geologist, to assist in planning and training activities to mitigate potential problems that may be caused by a volcanic eruption or other volcanic hazard.

Background. Awareness of the possiblity of a destructive volcanic eruption in California was reawakened by the recent eruption of Mount St. Helens in Washington State, and by apparent pre-volcanic seismicity and crustal swelling at the Long Valley caldera in Mono County. The volcanic hazards response program was formed to address that problem. Its first activity was the organization of a volcanic hazards workshop, in December 1981, sponsored jointly by the Department of Conservation and OES, and the publication of its proceedings, Special Publication 63 (SP 63). It has been largely a one-person program providing volcanologic advice relating to hazard assessment for DMG. It has assisted OES in the writing of Plan Caldera and various training exercises, and has provided liaison with the U.S. Geological Survey and other volcanologic study groups.

During fiscal year 1984-1985, review of monitoring and research on the Long Valley and other volcanic areas was continued. Reports on California volcanic hazards information were prepared monthly. A second edition of Plan Caldera was completed and assistance provided to OES in conducting a tabletop exercise for State, local, and other agencies concerned with a possible volcanic emergency at Long Valley. This exercise tested newly legislated powers of CEPEC (California Earthquake Prediction Evaluation Council) to deal with scientific predictions of volcanic activity.

Plans were made with seismology staff to more closely integrate functions of their newly acquired volcano-seismologic staff and equipment with the volcanic hazard response planning program. These augmentations have provided new capabilities for prediction of volcanic eruptions and greatly enhanced DMG's competence in volcanic hazard assessment.

V. Geologic Investigations Program

The Geologic Investigations Program provides both basic and applied geologic information--primarily, but not solely, in the form of maps. This information is used in mineral resource development, in land-use planning and regulation by local government, in timber harvest planning, in development-site evaluation studies, and in other endeavors requiring sound information on the geology of the state. The specific areas of program activity are (1) fault evaluation and zoning, (2) regional geologic mapping, and (3) forest watersheds mapping and timber harvest plan review.

1. Fault evaluation and zoning

The Division's fault evaluation and zoning unit was established by the Alquist-Priolo Special Studies Zones Act (APSSZ) of 1972 (Public Resources Code, Division 2, Chapter 7.5). The objective of the law is to provide for public safety from surface rupture in hazardous fault zones by restricting construction astride active fault breaks.

Under the APSSZ Act, the State Geologist delineates Special Studies Zones about one-quarter mile wide along potentially hazardous faults, including the San Andreas, Calaveras, Hayward, and San Jacinto faults. Under guidelines adopted by the State Mining and Geology Board, local governments permit certain development projects in the Special Studies Zones only after geologic studies show building sites to be free from hazardous faults. Generally, structures for human occupancy are not permitted within 50 feet of an identified trace of an active fault.

The Special Studies Zones (SSZ) maps delineate areas along active fault breaks found to be potentially hazardous because of possible surface rupture. These maps are drawn at a relatively large scale (one inch equals 2,000 feet) to assure that the boundaries of the zones are adequately displayed for land-use regulatory purposes.

The four major faults named in the Act--the San Andreas, the Calaveras, the Hayward, and the San Jacinto faults--were initially zoned on the basis of available existing data. When the zonation of other faults "sufficiently active and well-defined" (PRC, Sec. 2622) was begun, it became apparent that in many cases the available data were not sufficient for the purpose of zonation. In recognition of this insufficiency of data and the large number of potentially active faults in California that needed to be evaluated for possible zonation, in 1976 a Fault Mapping and Evaluation Program, with scheduled regional evaluations including field mapping and detailed interpretation of aerial photographs by DMG staff, was initiated as an augmentation of Special Studies Zones mapping unit. At this time, the criteria for zonation were refined based upon the Divison's zoning experience. Besides carrying out scheduled evaluations of specific regions of the state, the unit also evaluates previously zoned faults for possible revision or deletion when taking another look is warranted by new data. The Division's Fault Evaluation and Zoning Program is described fully in revised Special Publication 42, "Fault-Rupture Hazard Zones in California," which is expected to be published in September 1985.

Figure 5 shows the breakdown of regions in the state scheduled for evaluation, including the regions whose evaluation has been completed. Also shown in Figure 5 are the principal faults in California that have been zoned under the Alquist-Priolo Act.

During fiscal year 1984-85, final revisions were made on the 43 preliminary Review Maps of Special Studies Zones issued on January 1, 1985 to the five counties, and three cities affected by the zones. The number of Special Studies Zone maps issued to date now total 352. The newly established zones encompass active faults evaluated in the Sierra Nevada region in the preceding year. The faults evaluated are summarized briefly in the previous annual report and in more detail in the recently released Open-File Report 84-52 SF. Also released during the fiscal year were three maps showing evidence for recent faulting for several of the more improtant active faults along the east side of the Sierra Nevada (Open-File Reports 84-54, 84-55, and 84-56 SAC).

Meanwhile, fault evaluation studies were initiated and partially completed, in the southern Coast Ranges region (Figure 5). By the end of the fiscal year, evaluations indicated the need to establish new or revised zones for all or parts of the Ortigalita, Calaveras, Paicines, Quin Sabe, San Andreas, and Los Alamos faults. Other faults being evaluated in the southern Coast Ranges include the San Simeon, Sur, Tularcitos, Rinconada and several other faults. Evaluations will be completed by October 1, 1985. Preliminary Review Maps of Special Studies Zones are planned for release January 1, 1986.

Other evaluatins also were being undertaken simultaneously outside the study region for the Newport-Inglewood fault and part of the San Gabriel fault in Los Angeles and Orange counties and the San Cayetano and related faults in Ventura County in fiscal year 1984-85. Faults in regions previously studied were also evaluated based on new data. Some existing zones were revised as well.

For each fault evaluated under the Fault Evaluation and Zoning Program, a Fault Evaluation Report (FER) is prepared to summarize data on fault locations and recency, and to make zoning recommendations. By July 1, 1985, seven FER's had been completed and several others were underway or planned. A total of about 170 FER's have been completed since the inception of the Program in 1976 and are available for public reference at the Pleasant Hill and Los Angeles regional offices of the Division.

In addition to evaluating and zoning faults, other functions of the Division under the APSSZ Act include (1) the filing of geologic reports for development sites within the Special Studies Zones and (2) review of waiver requests in lieu of a geologic report as provided for in PRC, Sec. 2623. By the end of the 1984-85 fiscal year, a total of 1,800 geologic reports were on file and available for public reference at the San Francisco regional office. An index map, Open-File Report OFR 84-31 SF, identifying the sites investigated for faults under the Act, was released during the fiscal year. Only one waiver request was submitted during fiscal year 1984-85, making a total of 70 waivers processed to date.

Another important activity of the program staff is to provide information about the APSSZ Act, the Division's fault evaluation and zoning program, and fault-rupture hazards to both the public and private sectors. It is estimated that

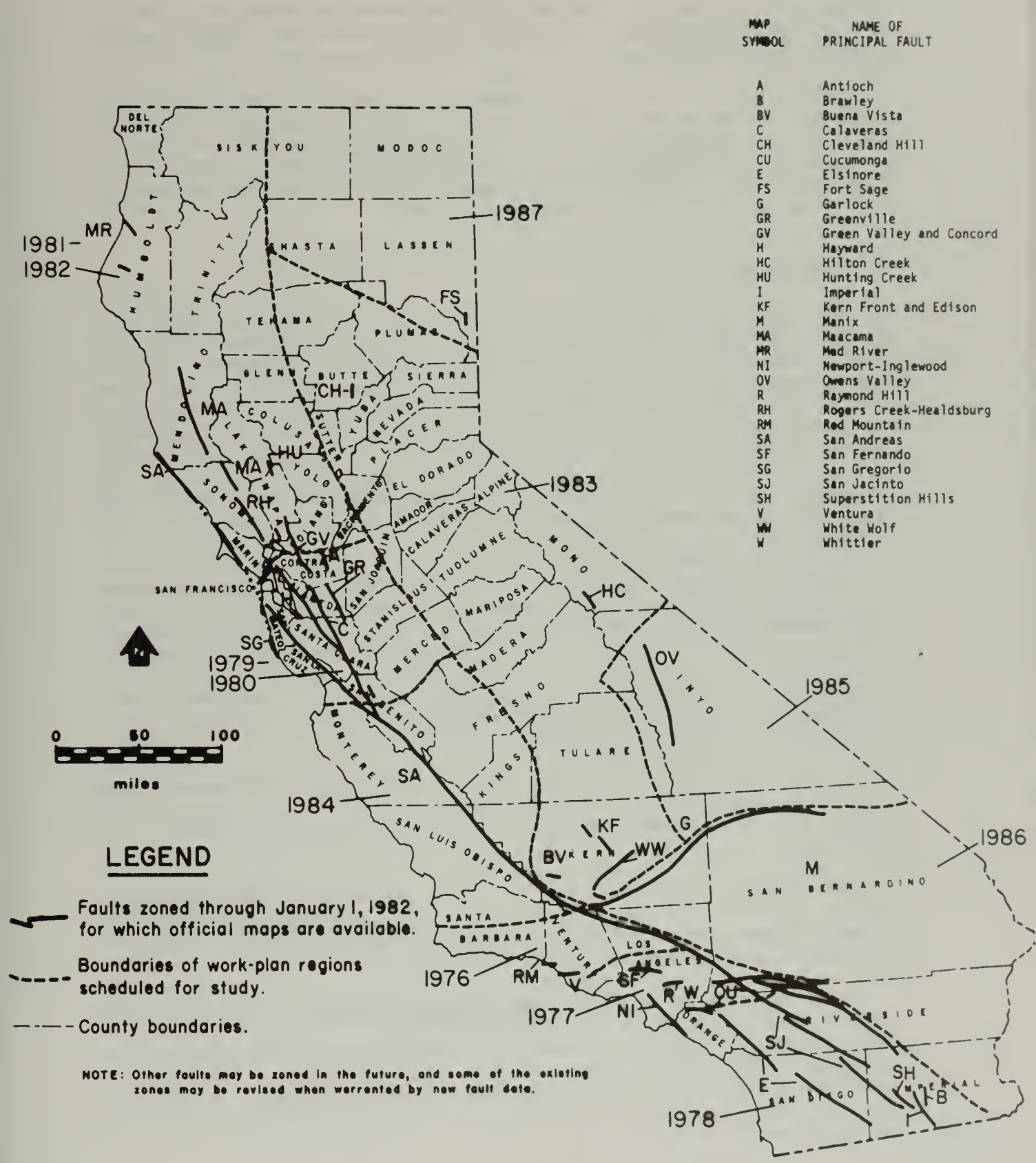


Figure 5. Principal faults in California zoned for special studies under the Alquist-Priolo Special Studies Zones Act of 1972. Dashed lines and dates identify work-plan and priorities for studying areas under the Fault Evaluation and Zoning Program, 1976 to 1988.

the program staff spent 15 to 20 percent of their time responding to hundreds of inquiries by geologists, planners, building officials, realtors, developers, financial institutions, and others.

Program staff also respond immediately after each moderate-to-large earthquake in order to map fault-rupture that may occur. During this fiscal year, the last such response was made following the April 24, 1984, Morgan Hill earthquake. Preparation of a report on the rupture along the segment of the Calaveras fault that caused the earthquake was completed and published (in DMG's Special Publication 68) during the fiscal year.

2. Regional geologic mapping

The Regional Geologic Mapping Program was established to prepare and maintain a baseline source of the most up-to-date geotechnical information on the geologic and seismologic framework of California. DMG staff scientists produce regional quadrangle maps (mostly 1 degree by 2 degrees in area, at a scale of 1:250,000) by compiling geological, geophysical, and seismological data obtained from DMG field work and photo interpretation, and from other geoscientists in State and Federal government, universities, and the private sector. The maps are used by government agencies at all levels and by the private sector. The information on the maps is used in mineral resource exploration, in initial stages of geologic hazard assessments, and in geologic investigations needed for major development and construction projects.

Charles W. Jennings, manager of the Regional Mapping Program, announced his retirement in April 1985 after a career of more than 33 years. Jennings was in charge of the preparation of DMG's Geologic Atlas of California. He authored DMG's 1:750,000-scale "Geologic Map of California" (1977) and the 1:750,000-scale "Fault Map of California" (1975). He is also the author of DMG Bulleton 201, a historical review and analysis of geological mapping in California, with an index to mapping used in DMG's Fault and Geologic Maps of California (scale 1:750,000). Bulletin 201 is scheduled for publication during Fiscal Year 1985-86.

The new Regional Geologic Map series was initiated in 1978 because most State Atlas sheets, also at 1:250,000 scale, were 15 to 20 years old and considerable new geologic mapping had been accomplished since they were published.

The first two maps in the Regional Geologic Map series have been printed and released. These are the Sacramento and Santa Rosa Quadrangles, the Santa Rosa Quadrangle having been released this fiscal year in September. Both maps have proved to be very useful and are selling at a brisk pace.

Compilation of the new San Bernardino Quadrangle, the first of the new series in southern California, was completed in June 1983. In-house and outside peer reviews were completed in 1983, and scribing for the printing plates began in September 1983, and was completed in June 1984. Color separations were completed in December 1984, and the map will be submitted to the printer in mid-1985. The San Bernardino Quadrangle is expected to be published during the next fiscal year.

The compilation of the Weed Quadrangle and peer review were completed early in 1983. Map scribing and lettering by laser technology by a private contractor was investigated as a possible way to expedite the publication of the regional geologic maps. The first plate was submitted to Stork Graphics in North Carolina for laser scribing in February 1985.

Work on the Trona-Kingman Quadrangle continued during this fiscal year. The compilation was completed in 1984 and the in-house review was completed in January 1985. The Trona-Kingman Quadrangle is expected to be published late in fiscal year 1985-86.

The preliminary stages of the compilation of a combined Santa Ana-San Diego Quadrangle were begun in May 1985.

Work continued on a new combination San Francisco-San Jose Quadrangle during the fiscal year. The area includes parts of the Coast Ranges, Great Valley and Sierra Nevada provinces as well as much of the San Francisco Bay area. The new geologic compilation will depict much new mapping done since the publication of the older San Francisco and San Jose sheets in 1962 and 1966 respectively. The San Francisco-San Jose Quadrangle is being prepared for outside peer review in 1985.

Several diverse geologic terranes are evident within the limits of the San Francisco-San Jose Quadrangle. From west to east these include: the Salinian block composed of a granitic core; the Diablo Range with its Franciscan core complex; the San Joaquin Valley which is comprised of coalescing alluvial fans and river basin deposits; the Sierran foothills made up of Mesozoic and Paleozoic arc and trench deposits; and the Sierra Nevada batholithic complex. There are also a number of major active faults on this quadrangle, including the San Andreas, Hayward, and Calaveras fault systems.

Compilation of a new Chico Quadrangle continued through the fiscal year. The area, which lies due north of and contiguous to the Sacramento Quadrangle, includes parts of the Sierra Nevada and Great Valley provinces. Approximately 75 percent of this new compilation will reflect geologic mapping completed since publication of the previous Chico sheet in 1962.

Prominent geologic features of the Chico Quadrangle include the Melones fault zone (part of the Foothills fault system), the intensely faulted Chico Monocline, and Sutter Buttes, a Quaternary volcano in the middle of the Sacramento Valley.

From an economic standpoint it is noteworthy that some of the most productive lode and placer gold districts in the northern Sierra Nevada are located in this area. These include the Allegheny, Downieville, La Porte, North Bloomfield, and Washington mining districts.

A revised Five-Year Plan for the preparation of 1:250,000-scale map sheets was prepared in January 1983. A graphic display of the sheets completed, underway, and proposed is shown in Figure 6.

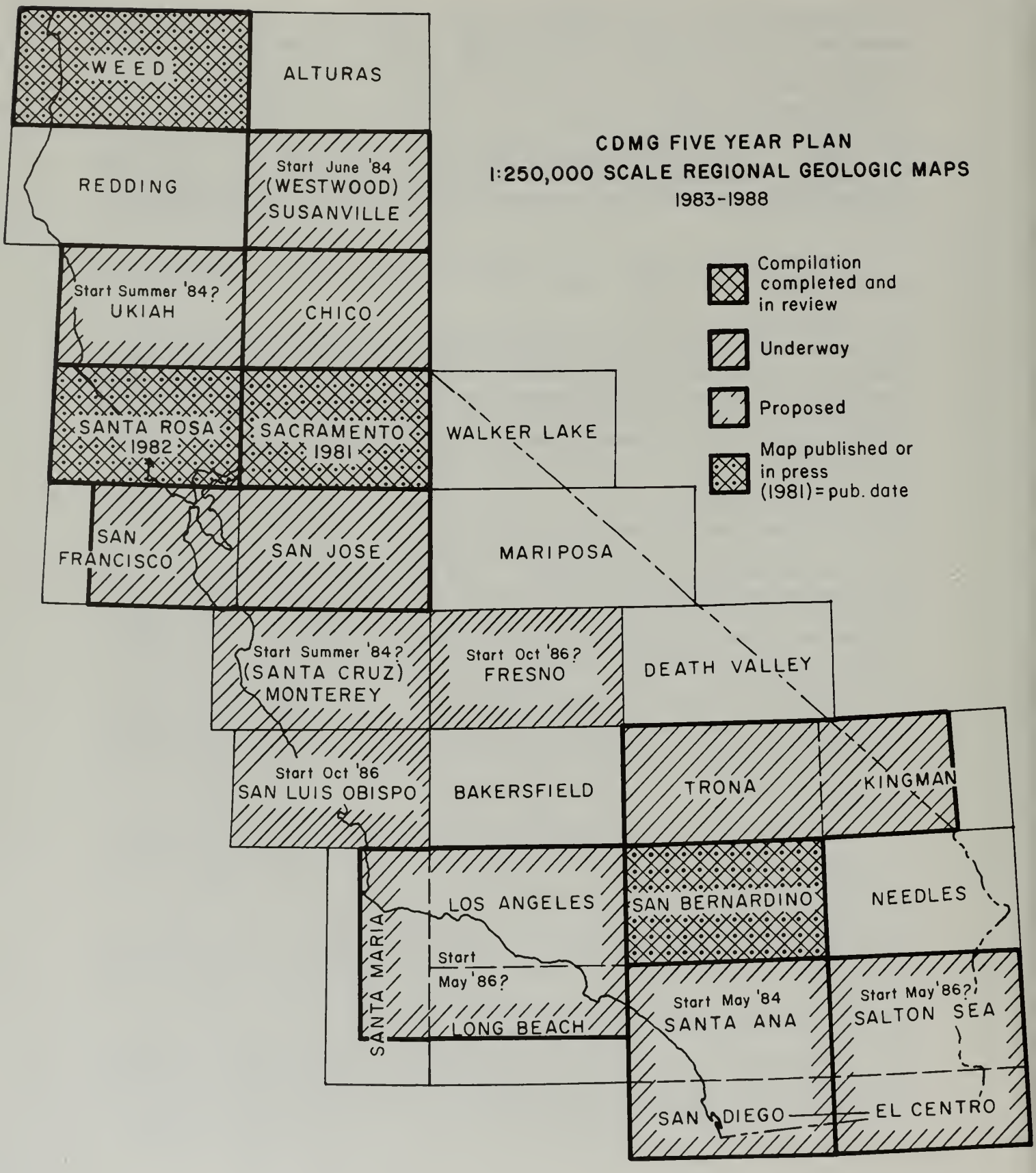


Figure 6. Status of the Regional Geologic Mapping Program.

Indices to basic geologic information. The staff of the Regional Geologic Mapping Program also prepares guides to the literature containing basic geologic mapping in California. These guides are essential, not only to the Division, but throughout the profession. Over the years, the Division has prepared and published indices to published areal geologic maps of California and to graduate theses on California geology.

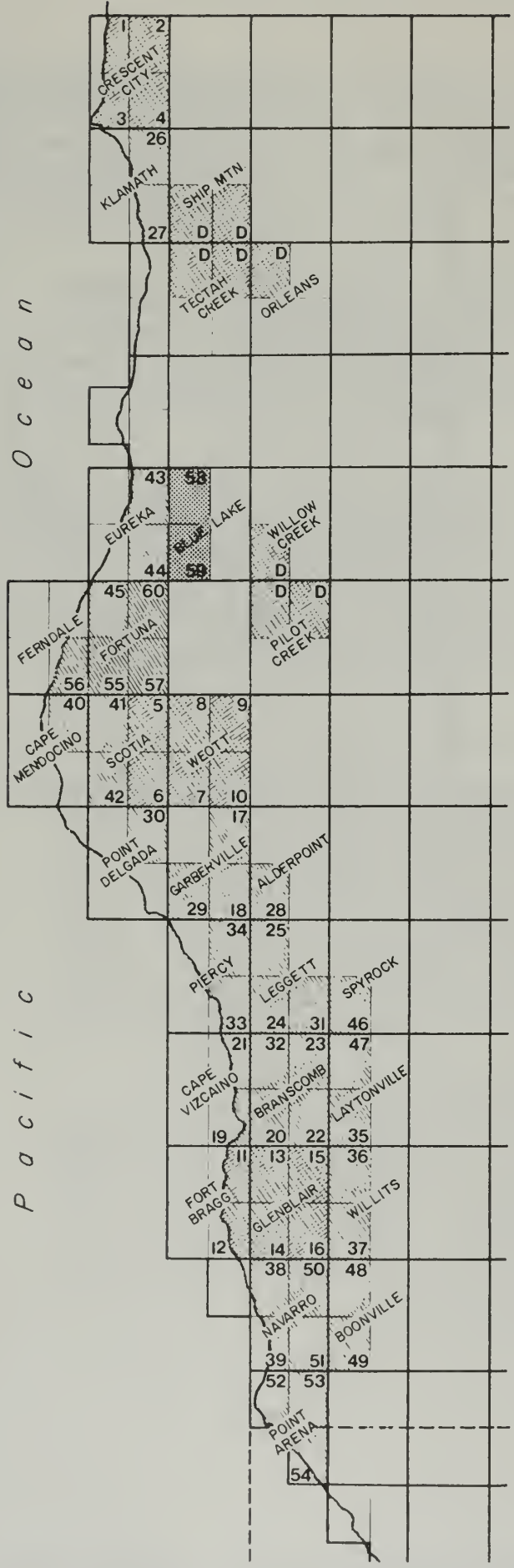
Index to published geologic maps of California. Special Report 130, published in 1977, was the last complete index to geologic maps of California. It covers the years 1969-1975. An abbreviated index to 1976 maps was published in the April 1981 issue of CALIFORNIA GEOLOGY, and another index of 1977-78 maps was published in the January 1983 issue. Because of other priorities and personnel shortages, no systematic indexing is currently underway, although the need is still present.

Indices to graduate theses on California geology. Geologic maps contained in doctoral dissertations and master's theses are often the most detailed mapping available for various areas of the state. The Division has published two major indices to graduate theses on California geology, Special Reports 74 and 115. The latter report, published in 1974, identifies maps for the years 1962 through 1972. Since then, supplements have been published in our CALIFORNIA GEOLOGY magazine, the latest in May 1984. This report listed theses for 1979 and 1982.

3. Forest watersheds mapping and timber harvest plan review

During fiscal year 1984-85 there were two concurrent Division programs that applied the principles of geology to timber management: California Department of Forestry (CDF) watersheds mapping, and geologic review of Timber Harvest Plans (THPs). The goal of the Watersheds Mapping Program is to gather and interpret data on geologic and geomorphic features related to landsliding in key forested watersheds of selected 7 1/2-minute quadrangles. The THP Review Program provides site-specific geologic review of proposed harvesting areas and recommendations for mitigative measures for potential landslide and/or erosion problems. Under the Forest Practice Act of 1973, THPs are submitted to CDF in lieu of EIRs and are reviewed by numerous State agencies to insure that their functional equivalency is retained.

The end of fiscal year 1984-85 marked the conclusion of DMG watersheds mapping under the CDF/DMG contract. The watersheds maps emphasize surficial geologic and geomorphic units. The maps are prepared by interpretation of aerial photographs, field mapping, and compilation of published and unpublished maps and reports. Forest land managers, the logging industry, planners, and other users of the forest lands are the primary users of the watersheds maps. By the end of fiscal year 1984-85, staff geologists completed mapping for sixty 7.5' quadrangles (see Figure 7).



LEGEND

MAPPING COMPLETED; EPA-208 CONTRACTS

MAPPING COMPLETED or UNDERWAY; CDF/CDMG CONTRACT

MAPPING PLANNED, FY 84-85; CDF/CDMG CONTRACT

D *QUADRANGLE MAPPED BY DWR (NAMES NOT LISTED)*

4 *QUADRANGLE MAPPED BY CDF/CDMG; KEYED TO LIST BELOW*

1. Smith River
2. High Divide
3. Crescent City
4. Hiouchi
5. Scotia
6. Bull Creek
7. Weott
8. Redcrest
9. Bridgeville
10. Myers Flat
11. Fort Bragg
12. Mendocino
13. Glenblair NW
14. Glenblair SW
15. Glenblair NE
16. Glenblair SE
17. Miranda
18. Garberville
19. Inglenook
20. Dutchmans Knoll
21. Westport
22. Sherwood Peak
23. Cahto Peak
24. Leggett
25. Noble Butte
26. Childs Hill
27. Requa
28. Harris
29. Briceland
30. Honeydew
31. Tan Oak Park
32. Lincoln Ridge
33. Hales Grove
34. Piercy
35. Longvale
36. Willits NW
37. Willits SW
38. Elk
39. Mallo Pass Creek
40. Capetown
41. Taylor Peak
42. Buckeye Mtn
43. Arcata North
44. Arcata South
45. Fields Landing
46. Iron Peak
47. Laytonville
48. Boonville NW
49. Boonville SW
50. Navarro NE
51. Navarro SE
52. Point Arena
53. Point Arena NE
54. Gualala
55. Fortuna
56. Ferndale
57. Hydesville
58. Blue Lake
59. Korbel
60. McWhinney Creek

Figure 7. Status of the Forest Watersheds Mapping Program.

Available and planned CDF/DMG watersheds maps are listed in Table 2. Blueline copies of the available maps may be purchased for a nominal fee ($4.00) at either of the following:

California Dept. of Forestry
3314 Bechelli Lane
Redding, CA 96002
Telephone: (916) 246-6367

California Dept. of Conservation
Division of Mines and Geology
380 Civic Drive
Pleasant Hill, CA 94523
Telephone: (415) 671-4920

During 1984-85, one staff geologist was assigned to the Watersheds Mapping Program. This position was located in the CDF Santa Rosa office.

Under the Timber Harvest Plan (THP) review program, Division staff geologists perform the following tasks: (1) screen incoming THPs for geologic review; (2) provide geologic input for the review of THPs; (3) reinspect THPs to evaluate mitigative measures recommended during preharvest inspections; (4) provide assistance in the preparation of training classes for professional foresters who are providing CDF inspections; and (5) provide advice to CDF and the Board of Forestry on issues involving geology, such as changes in Forest Practice Rules, chaparral management, and silviculture methods. During fiscal year 1984-85, there were four geologist positions assigned to the THP Program. Approximately 250 geologic reviews of THPs were completed.

Table 2. Available CDF/DMG watersheds maps, with county and DMG open-file number.

7.5-MINUTE QUADRANGLE	COUNTY	DMG OPEN-FILE NO.
EPA-208 Watersheds Maps (1981-83 Contract) (Calif. WQCB, Phase III)		
Smith River	Del Norte	83-19 SF
High Divide	Del Norte	83-18 SF
Crescent City	Del Norte	82-21 SF
Hiochi	Del Norte	83-4 SF
Scotia	Humboldt	82-20 SF
Bull Creek	Humboldt	83-3 SF
Weott	Humboldt	83-6 SF
Redcrest	Humboldt	83-17 SF
Bridgeville	Humboldt	83-23 SF
Myers Flat	Humboldt	83-22 SF
Fort Bragg	Mendocino	83-5 SF
Mendocino	Mendocino	83-15 SF
Glenblair NW	Mendocino	82-25 SF
Glenblaie SW	Mendocino	83-20 SF
Glenblair NE	Mendocino	82-19 SF
Glenblair SE	Mendocino	83-21 SF
CDMG/CDPR Watersheds Maps (1982-83 Contract)		
Miranda	Humboldt	83-25 SF
Garberville	Humboldt	83-26 SF
CDMG/CDF Watersheds Maps (1982-85 Contract)		
Inglenook	Mendocino	83-31 SF
Dutchmans Knoll	Mendocino	83-33 SF
Westport	Mendocino	83-32 SF
Sherwood Peak	Mendocino	83-38 SF
Cahto Peak	Mendocino	83-39 SF
Leggett	Mendocino	83-40 SF
Noble Butte	Mendocino	83-41 SF
Childs Hill	Del Norte	84-7 SF
Requa	Del Norte	84-8 SF
Harris	Humboldt	84-9 SF
Briceland	Humboldt	83-10 SF
Honeydew	Humboldt	84-11 SF

7.5-MINUTE QUADRANGLE	COUNTY	DMG OPEN-FILE NO.
Tan Oak Park	Mendocino	84-17 SF
Lincoln Ridge	Mendocino	84-14 SF
Hales Grove	Mendocino	84-15 SF
Piercy	Mendocino	84-16 SF
Longvale	Mendocino	84-18 SF
Willits NW	Mendocino	84-19 SF
Willits SW	Mendocino	84-20 SF
Elk	Mendocino	84-12 SF
Mallo Pass Creek	Mendocino	84-13 SF
Capetown	Humboldt	84-34 SF
Ferndale	Humboldt	84-35 SF
Taylor Peak	Humboldt	84-36 SF
Buckeye Mtn	Humboldt	84-37 SF
Arcata North	Humboldt	84-38 SF
Arcata South	Humboldt	84-39 SF
Iron Peak	Mendocino	84-40 SF
Laytonville	Mendocino	84-41 SF
Boonville NW	Mendocino	84-42 SF
Boonville SW	Mendocino	84-43 SF
Navarro NE	Mendocino	84-44 SF
Navarro SE	Mendocino	84-45 SF
Point arena	Mendocino	84-46 SF
Point Arena NE	Mendocino	84-47 SF
Gualala	Mendocino	84-48 SF
Fortuna	Humboldt	85-1 SF
Hydesville	Humboldt	85-2 SF
McWhinney Creek	Humboldt	85-3 SF
Fields Landing	Humboldt	85-4 SF
Korbel	Humboldt	85-5 SF
Blue Lake	Humboldt	85-6 SF

For further information concerning the DMG/CDF Watersheds Maps, please contact Trinda Bedrossian, Senior Geologist, Department of Conservation, Division of Mines and Geology, Post Office Box 670, Santa Rosa, California 95402; telephone (707) 576-2275.

VI. Geologic Information Program

The Geologic Information Program makes information prepared by Division program activities and other pertinent geologic information available to the general public, including local government, the scientific community, and the public at large. The program also provides technical review of siting reports for certain proposed developments within the state. Specific areas of program activity are (1) information and publications sales, (2) publications production, (3) earth science library, and (4) siting report review.

1. Information service and publications sales

An information service and sales desk is maintained at each of the Division's three regional offices (one at 380 Civic Drive in Pleasant Hill; one at 1516 Ninth Street in Sacramento; and one at 107 South Broadway in Los Angeles). Thousands of inquiries are received at each of these offices annually. Many questions can be answered by supplying copies of DMG Notes or particular issues of CALIFORNIA GEOLOGY. Members of the scientific staff are available to respond to specific technical questions that require the application of specialized professional judgment to answer. For some inquiries, an individual letter from a member of the Division's technical staff is warranted.

Division publications are sold over the counter at these three regional offices, and are available for mail-order purchase from: DMG, P.O. Box 2980, Sacramento, CA 95812. Order prices for individual publications are given in the Division's current "List of Available Publications." Revenue from the sale of Division publications during fiscal year 1984-85 amounted to $112,000.

When a new Division publication is first released to the public, copies are supplied to all "complete depository" libraries in the state, including the State Library, all University of California campus libraries, certain State University campus libraries, and the municipal library systems of Los Angeles, San Diego, San Francisco, and Oakland. Complete depository libraries therefore should have all in-print and out-of-print DMG publications.

2. Publications production

Information about the geology, mineral resources, and geologic hazards of California is published by the Division and distributed to professionals and interested lay-persons. The results of studies made by scientific staff members of the Division and others in the earth science professions are published in CALIFORNIA GEOLOGY, the Division's monthly magazine, and in bulletins, special reports, special publications, preliminary reports, map sheets, geologic maps, open-file reports, and special information pamphlets called DMG Notes. News releases concerning the Division's publications and activities are prepared and distributed to the media.

In producing these publications, the publications staff reviews the technical content of manuscripts, edits manuscripts and maps, drafts illustrations and maps, does graphic design and layout of all publications, coordinates printing and lithography, negotiates printing contracts, and manages the printing budget.

a. New publications released

Seventy-sixth Report of the State Geologist (1983-1984). No charge. This annual report explains the goals of the Division, describes its organization and programs, reports activities of the fiscal year, and lists Division personnel.

County Report Number 2. Mines and Mineral Resources of Calaveras County, California. By William B. Clark and Philip A. Lydon. 1962 (Reprint). $10.00. 217 pages. Since 1880, the value of the total recorded mineral production for Calaveras County has been 200 million dollars. Of this amount, gold, copper, limestone, and limestone products have accounted for the greatest portion. Other mineral commodities that have been produced in quantity include zinc, silver, lead, chromite, clay, stone, and sand and gravel.

Special Publication 68. The Morgan Hill, California Earthquake. Edited by John H. Bennett and Roger W. Sherburne. 1984. $12.50. 271 pages. This report is a collection of studies of various aspects of the April 24, 1984 Morgan Hill earthquake. The 24 papers in the publication present the work of 56 investigators representing 21 organizations. Among the authors are engineers, scientists, emergency-response officials and others in government, the universities, utilities, and consulting firms. Of special concern are the response of modern structures to earthquake motion, the extent to which the source rupture may focus energy, the pattern of seismicity in the region, and the adequacy of emergency-response procedures.

Special Publication 69. An Annotated Bibliography of Geothermal Information Published or Authored by Staff of the California Division of Mines and Geology, 1960-1984. By Leslie G. Youngs. 1984. $2.00. 20 pages. One-hundred and three references or announcements published by DMG concerning geothermal resources are annotated in this bibliography. Included are articles and announcements from MINERAL INFORMATION SERVICE and CALIFORNIA GEOLOGY magazine.

Special Publication 70. Mineral Commodity Report - Potash. By Gary Taylor. 1984. $1.00. 12 pages. This report summarizes the current mineral economics of potash--worldwide, with special focus on California. About 95 percent of the potassium compounds (commonly referred to as the oxide, "Potash," K_2O) produced in the world are utilized as fertilizers.

Special Publication 71. Mineral Commodity Report - Titanium (Including Rutile and Ilmenite). By Marjorie Bushnell. 1984. $1.00. 15 pages. This report summarizes the current mineral economics of titanium-- worldwide, with special focus on California. The greatest use for titanium metal is in the aerospace industry.

Special Publication 72. Mineral Commodity Report - Gypsum. By John L. Burnett. 1984. $1.00. This report summarizes the current mineral economics of gypsum--worldwide, with special focus on California. Gypsum is basic to two major industries in California, construction and agriculture.

Special Publication 73. Mineral Commodity Report - Lime (Quicklime, Hydrated Lime, and Dead-Burned Dolomite). By Marjorie Bushnell. 1984. $1.00. 11 pages. This report summarizes the current mineral economics of lime--worldwide, with special focus on California. Lime is the common name for calcium oxide (CaO) and has significant applications in such areas as (1) the manufacture of industrial and agricultural chemicals and pharmaceutical products, (2) decreasing the expansive properties of certain clay soils, and (3) neutralizing acid conditions present in industrial effluent and in waste-water treatment.

Special Publication 74. Mineral Commodity Report - Sulphur. By Melvin C. Stinson. 1984. $1.00. 18 pages. This report summarizes the current mineral economics of sulphur--worldwide, with special focus on California. Sulphur's many and varied uses include the production of sulphuric acid, an acid used so extensively by modern industry as to be considered an index of a nation's economic activity.

Special Publication 75. Mineral Commodity Report - Zeolite. By Melvin C. Stinson. 1984. $1.00. 21 pages. This report summarizes the current mineral economics of zeolite--worldwide, with special focus on California. Although most zeolites produced in the United States are synthetic, markets for the naturally-occuring mineral and its application in water purification are being researched and developed.

Special Publication 76. Mineral Commodity Report - Barite. By Michael A. Silva. 1984. $1.00. 14 pages. This report summarizes the current mineral economics of barite--worldwide, with special focus on California. This soft, heavy, and chemically inert material is being produced primarily for use in weighted muds for oil and gas well drilling.

Special Publication 77. Mineral Commodity Report - Magnesium Compounds. By Hasmukhrai H. Majmundar. 1985. $1.00. 15 pages. This report summarizes the current mineral economics of magnesium compounds--worldwide, with special focus on California. Markets served by the industries manufacturing magnesium compounds are steel, glass, portland cement, copper and lead industries, and the magnesia calcining plants (refractories) themselves.

Special Publication 79. Mineral Commodity Report - Anhydrous Ammonia (Nitrogen). By Gary Taylor. 1985. $1.00. 9 pages. This report summarizes the current mineral economics of nitrogen--worldwide, with special focus on California. Of the 15 million tons of ammonia (NH_3) produced in the United States, nearly 80 percent was used as fertilizer, with the remaining 20 percent used to produce plastics, resins, explosives, and other chemicals.

Special Publication 80. Mineral Commodity Report - Calcium Chloride. By Hasmukhrai H. Majmundar. 1985. $1.00. 12 pages. This report summarizes the current mineral economics of calcium chloride--worldwide, with special focus on California. Calcium chloride is utilized mostly because of its capacity for absorbing water and the tendency of its solutions to freeze at low temperatures. The bulk of calcium chloride produced is used for road de-icing.

Special Report 118. San Andreas Fault in Southern California. Edited by John C. Crowell. 1975 (Reprint). $4.50. 272 pages. This report examines faults of the San Andreas system at selected localities in southern California and attempts to understand its characteristics and history.

Special Report 119. Landsliding in Marine Terrace Terrain, California. By George B. Cleveland. 1975 (Reprint). $1.00. 24 pages. This paper, which is based on reconnaissance field inspection and air photo interpretation of areas along the California coastline, examines the occurrence and nature of landslides.

Special Report 155. Stabilization of Landslides: Effects of Various Chemicals on the Laboratory Shear Strength of an Expansive Soil. By Glenn Borchardt. 1984. $3.25. 65 pages. This report evaluates the effectiveness of various chemicals as additives to expansive soils (such as the smectitic Diablo clay) for stabilizing slopes against landsliding. Effects of various chemicals upon the shear strength of Diablo clay are examined to find the chemicals that produce precipitates, or cementing agents, in the soil. The report will be of interest to scientists and government officials who are concerned with the problem of stabilizing failure-prone slopes, as well as residents of hilly or mountainous areas throughout the state.

Bulletin 190. Geology of Northern California. Edited by Edgar H. Bailey. 1966 (Reprint). $10.00. 508 pages. This bulletin addresses each of the natural provinces of northern California. The geological history for each province is different from that of its neighbor, and consequently the rocks, structures, mineral deposits, and geomorphology also are different. The Klamath Mountains, Cascade Range, Modoc Plateau, Sierra Nevada, Great Valley, and Coast Ranges comprise the area generally regarded as northern California.

Bulletin 193. Gold Districts of California. By William B. Clark. 1970 (Reprint). $8.00. 186 pages. This bulletin is an overall guide to gold deposits in California. The principal features of each gold-bearing district are described, including location and extent, history, geology and character of the ore deposits, a list of mines, and a bibliography. Production figures are given when possible.

Bulletin 202. Geology of the Point Reyes Peninsula, Marin County, California. By Alan J. Galloway. 1977 (Reprint). $6.00. 72 pages. This book describes Point Reyes Peninsula in terms of its four geologically distinct areas, and is designed to be both a comprehensive report for the geologist and a source of information for the interested layman.

Map Sheet 34. Geology of the North half of the Confidence Hills 15-Minute Quadrangle, Inyo County. By Lauren A. Wright and Bennie W. Troxel. 1984. $5.50. One map sheet and 31 pages of text. The geologic map and cross section are printed in color on the map sheet and depict the geologic structure and rock units of the area. The map is on a topographic base at a scale of 1:24,000.

Geologic Data Map No. 2. Geologic Map of California. Compiled by Charles W. Jennings. 1977 (Reprint). $8.00, scale: 1:750,000. This is a 4-foot-by-5-foot, colored map showing the statewide surface distribution of geologic units.

Geologic Data Map No. 5. Technical Map of Geothermal Resources of California, with accompanying text. By Hasmukhrai H. Majmundar. 1984. $10.00. This map and text show the relationship of tectonic features (faults and volcanoes) to the occurrence of geothermal resources, and provides a geochemical key to the mineral content of subsurface waters. The map and text are intended primarily for use by the scientific or technical community.

b. California Geology

The following articles were published during the year in the Division's monthly earth science magazine CALIFORNIA GEOLOGY:

Morgan Hill Earthquake of April 1984
Morgan Hill Earthquake Caused Record Shaking Force
Surface Faulting Associated with the Morgan Hill Earthquake of April 24, 1984
Landslide Hazards in California
1983 Mining Review
Mineral Resource Potential of the Rockhouse Basin Wilderness Study
Geology of Santa Catalina Island
Earthquake Damage in the Sacramento-San Joaquin Delta
Shallow Marine Deposits in Boyden Cave Roof Pendant in the West-Central Sierra Nevada
Quarterly Update--Gold Mining in California
Seismicity of California, April 1979 - October 1982, an Update
When the Big One Strikes
Earthquake Planning Scenarios for Magnitude 8.3 Earthquakes on the San Andreas Fault near Los Angeles and near San Francisco, California
Relative Earthquake Safety in Buildings

c. Open-File Reports

The DMG open-file report series consists of reports and maps that present reliable geological information in a relatively unpolished form, generally as copies of a typescript text and ozalid maps. Information is released in this way in order to make it available to users in the shortest possible time or because the nature of the information does not warrant more formal publication.

DMG open-file reports and maps are available for reference at the information sections of the Los Angeles, San Francisco Bay area, and Sacramento offices. Unless otherwise announced, an open-file report (OFR) can be purchased (at cost of reproduction) through the DMG office that has the OFR on open file. The office that has any particular OFR on file is indicated by the final letters of the publication's number, as follows: LA (Los Angeles Office); SF (San Francisco Bay area office); and SAC (Sacramento Office).

SAN FRANCISCO AREA REGIONAL OFFICE

OFR 84-19 SF. Geology and Geomorphic Features Related to Landsliding, Willits NW 7.5' Quadrangle, Mendocino County, California. Compiled by Richard T. Kilbourne. Scale 1:24,000.

and

OFR 84-20 SF. Geology and Geomorphic Features Related to Landsliding, Willits SW 7.5' Quadrangle, Mendocino County, California. Compiled by Richard T. Kilbourne. Scale 1:24,000.

These maps were prepared under contract with the California Department of Forestry (CDF). They are released as part of a study to provide regional scale geologic mapping of sensitive north coast watersheds. The maps depict geology and geomorphic features related to landsliding, including translational/rotational slides, earthflows, debris slides, debris flow/torrent tracks, debris slide slopes, disrupted ground, and small active slides. Results of the studies may be used for land-use planning as general background information for the preparation of timber harvesting plans. It is anticipated that geologic and landslide-related data from the maps will be used (1) in the preparation and review of timber harvesting plans submitted to CDF prior to logging on State and private lands, and (2) as a guide to land managers for recognizing areas that should receive on-site geologic review prior to development of potentially unstable ground.

OFR 84-31 SF. Index to Geologic Reports for Sites within Special Studies Zones. By Perry Wong. 1984. Two plates (1:1,000,000 and 1:100,000 scale) with explanation. Under the Alquist-Priolo Special Studies Zones Act, the State Geologist establishes regulatory zones in order to mitigate the hazard of surface fault rupture. Sites proposed for development within these zones are required to have geologic investigations before development permits are issued by cities and counties. Copies of these investigative reports are filed with the California Division of Mines and Geology, as well as with various cities and counties.

OFR 84-34 SF. Geology and Geomorphic Features Related to Landsliding, Capetown 7.5' Quadrangle, Humboldt County. Compiled by Thomas E. Spittler. Scale 1:24,000.

and

OFR 84-35 SF. Geology and Geomorphic Features Related to Landsliding, Ferndale 7.5' Quadrangle, Humboldt County, California. Compiled by Thomas E. Spittler. Scale 1:24,000.

and

OFR 84-36 SF. Geology and Geomorphic Features Related to Landsliding, Taylor Peak 7.5' Quadrangle, Humboldt County, California. Compiled by Thomas E. Spittler. Scale 1:24,000.

and

OFR 84-37 SF. Geology and Geomorphic Features Related to Landsliding, Buckeye Mountain 7.5' Quadrangle, Humboldt County, California. Compiled by Thomas E. Spittler. Scale 1:24,000.

and

OFR 84-38 SF. Geology and Geomorphic Features Related to Landsliding, Arcata North 7.5' Quadrangle, Humboldt County, California. Compiled by Frederic R. Kelley. Scale 1:24,000.

and

OFR 84-39 SF. Geology and Geomorphic Features Related to Landsliding, Arcata South 7.5' Quadrangle, Humboldt County, California. Compiled by Frederic R. Kelley. Scale 1:24,000.

and

OFR 84-40 SF. Geology and Geomorphic Features Related to Landsliding, Iron Peak 7.5' Quadrangle, Mendocino County, California. Compiled by Richard T. Kilbourne. Scale 1:24,000.

and

OFR 84-41 SF. Geology and Geomorphic Features Related to Landsliding, Laytonville NE 7.5' Quadrangle, Mendocino County, California. Compiled by Richard T. Kilbourne. Scale 1:24,000.

and

OFR 84-42 SF. Geology and Geomorphic Features Related to Landsliding, Boonville NW 7.5' Quadrangle, Mendocino County, California. Compiled by Richard T. Kilbourne. Scale 1:24,000.

and

OFR 84-43 SF. Geology and Geomorphic Features Related to Landsliding, Boonville SW 7.5' Quadrangle, Mendocino County, California. Compiled by Michael W. Manson. Scale 1:24,000.

and

OFR 84-44 SF. Geology and Geomorphic Features Related to Landsliding, Navarro NE 7.5' Quadrangle, Mendocino County, California. Compiled by Michael W. Manson. Scale 1:24,000.

and

OFR 84-45 SF. Geology and Geomorphic Features Related to Landsliding, Navarro SE 7.5' Quadrangle, Mendocino County, California. Compiled by Michael W. Manson. Scale 1:24,000.

and

OFR 84-46 SF. Geology and Geomorphic Features Related to Landsliding, Point Arena 7.5' Quadrangle, Mendocino County, California. Compiled by Clifton W. Davenport. Scale 1:24,000.

and

OFR 84-47 SF. Geology and Geomorphic Features Related to Landsliding, Point Arena NE 7.5' Quadrangle, Mendocino County, California. Compiled by Clifton W. Davenport. Scale 1:24,000.

and

OFR 84-48 SF. Geology and Geomorphic Features Related to Landsliding, Gualala NE 7.5' Quadrangle, Mendocino County, California. Compiled by Clifton W. Davenport. Scale 1:24,000.

These maps were prepared under contract with the California Department of Forestry (CDF). They are released as part of a study to provide regional scale geologic mapping of sensitive north coast watersheds. The maps depict geology and geomorphic features related to landsliding, including translational/rotational slides, earthflows, debris slides, debris flow/torrent tracks, debris slide slopes, disrupted ground, and small active slides. Results

of the studies may be used for land-use planning as general background information for the preparation of timber harvesting plans. It is anticipated that geologic and landslide-related data from the maps will be used (1) in the preparation and review of timber harvesting plans submitted to CDF prior to logging on State and private lands, and (2) as a guide to land managers for recognizing areas that should receive on-site geologic review prior to development of potentially unstable ground.

OFR 84-52 SF. Summary Report - Fault Evaluation Program, 1983 Area (Sierra Nevada Region). By E.W. Hart, W.A. Bryant, and T.C. Smith, August 1983. 8 pages, 2 figures, 1 table, 2 plates. Scale 1:500,000. This report summarizes the study results for the sixth of ten areas to be evaluated under the statewide Fault Evaluation Program. (The first five areas evaluated are in southern California and in the central and northern coast ranges regions, and are summarized by Open-File Reports 77-8 SF, 78-10 SF, 79-10 SF, 81-3 SF, and 83-10 SF.) The region includes most of the Sierra Nevada and adjacent portions of the Great Valley and Basin and Ranges. During 1983, numerous potentially active faults were evaluated relative to the hazard of surface fault rupture. As a result of this work, 43 new and revised Special Studies Zones maps were issued for Preliminary Review on July 1, 1984. The proposed zones encompass segments of the Sierra Nevada and Owens Valley fault zones, as well as the Pleito, Kern Front, Premier, Nunez, White Mountains and Fish Slough faults.

OFR 85-1 SF. Geology and Geomorphic Features Related to Landsliding, Fortuna 7.5' Quadrangle, Humboldt County, California. Compiled by Richard T. Kilbourne. Scale 1:24,000.

and

OFR 85-2 SF. Geology and Geomorphic Features Related to Landsliding, Hydesville NE 7.5' Quadrangle, Humboldt County, California. Compiled by Richard T. Kilbourne. Scale 1:24,000.

and

OFR 85-3 SF. Geology and Geomorphic Features Related to Landsliding, McWhinney Creek 7.5' Quadrangle, Humboldt County, California. Compiled by Richard T. Kilbourne. Scale 1:24,000.

and

OFR 85-4 SF. Geology and Geomorphic Features Related to Landsliding, Fields Landing NW 7.5' Quadrangle, Humboldt County, California. Compiled by Richard T. Kilbourne. Scale 1:24,000.

and

OFR 85-5 SF. Geology and Geomorphic Features Related to Landsliding, Korbel 7.5' Quadrangle, Humboldt County, California. Compiled by Richard T. Kilbourne. Scale 1:24,000.

and

OFR 85-6 SF. Geology and Geomorphic Features Related to Landsliding, Blue Lake 7.5' Quadrangle, Humboldt County, California. Compiled by Richard T. Kilbourne. Scale 1:24,000.

These maps were prepared under contract with the California Department of Forestry (CDF). They are released as part of a study to provide regional-scale geologic mapping of sensitive north coast watersheds. The maps depict geology and geomorphic features related to landsliding, including translational/rotational slides, earthflows, debris slides, debris flow/torrent tracks, debris slides slopes, disrupted ground, and small active slides. Results

of the studies may be used for land-use planning as general background information for the preparation of timber harvesting plans. It is anticipated that geologic and landslide-related data from the maps will be used (1) in the preparation and review of timber harvesting plans submitted to CDF prior to logging on State and private lands and (2) as a guide to land managers for recognizing areas that should receive on-site geologic review prior to development of potentially unstable ground.

OFR 85-9 SF. Geologic map of a portion of the Manley Peak quadrangle, southern Panamint Mountains, California. By J.M.G. Miller. This areal geologic map was used in the compilation of the Trona-Kingman Quadrangle (1:250,000 scale) of the Division of Mines and Geology Regional Geologic Map Series. The main objective of the project was to document evidence that the Kingston Peak Formation records a Precambrian glaciation of what is now North America.

OFR 85-11 SF. Bedrock geologic map of the Shoo Fly Complex in the Jupiter area, Stanislaus River drainage, Tuolumne County, California. By Charles Merguerian. The report consists of 4 map sheets (1:24,000 scale) and a 32-page descriptive text. The report presents a detailed description of the lithology, structure and metamorphism of the Shoo Fly Complex and the structure and deformation related to the Calaveras-Shoo Fly thrust.

LOS ANGELES REGIONAL OFFICE

OFR 81-10 LA. Classification and Mapping of Quaternary Sedimentary Deposits for Purposes of Seismic Zonation, South Coastal Los Angeles Basin, Orange County, California (Final Technical Report). The report presents the results of a three-year study whose purpose was (a) to delineate areas of relative liquefaction and differential settlement susceptibility, (b) to perform basic studies for evaluating the potential for seismic shaking within the area, and (c) to develop a computer program capable of archiving geologic data, detecting anomalies within the data, and retrieving and displaying the data in either point or layer representation.

OFR 84-49 LA. Geology of the Northeast Quarter of the Newhall Quadrangle, Los Angeles County, California. By Drew P. Smith. 42 pages. Scale 1:9,600. This report and the accompanying large-scale (1 inch equals 800 feet) geologic map are the result of a study of the geology of an area of 15 square miles (39.5 square km) in west-central Los Angeles County about 30 miles (50 km) northwest of the Los Angeles Civic Center, immediately north of the towns of Newhall and Saugus. The study was undertaken to provide a detailed geologic map useful for local land-use planning, to augment and improve the geologic knowledge of the area, including subsurface geology, and to identify potential geologic hazards. Landsliding is widespread in the northern third of the area.

OFR 84-51 LA. Mineral-Land Classification of Halloran Spring, 15-Minute Quadrangle, San Bernardino County, California. Compiled by Richard B. Greenwood. Scale: 1:48,000. This report is one in a series that evaluates the mineral potential in non-urban areas of the state, pursuant to the Surface Mining and Reclamation Act of 1975. The Halloran Spring area of about 240 square miles in central San Bernardino County is a part of the highly

mineralized California Desert Conservation Area that continues to be the subject of Federal land-use planning activities. Gold and silver deposits at the old Telegraph mine area are now being re-evaluated for possible mine development. The mineral-land classification report identifies four porphyry copper-bearing areas and the location of sources of talc and volcanic cinders that are suitable for a variety of uses, as well as carbonate rock and quartzite deposits.

OFR 84-57 LA. Classification of Landslide Propensity in the Dana Point Quadrangle, Orange County, California. By Siang S. Tan. 23 pages. Map scale 1:12,000. The report and map are the result of a study undertaken to evaluate the propensity for landslides and other forms of slope failure in an urbanizing area of coastal southern California. The report discusses the development of a system of classification of slope stability, the aspects of the system, the data used, and the assumptions and compromises required to tailor the system to actual geologic and topographic conditions. The accompanying interpretative map, upon which zones of different degrees of slope stability are delineated, is the result of application of the system. The map is intended as an aid in planning and determining land use.

OFR 84-58 LA. Engineering Geology of Part of the Western Half of the Santiago Peak Quadrangle, Orange County, California. By Russell V. Miller and Paul K. Morton. 62 pages. Map scale 1:12,000. The report and accompanying large-scale (1 inch equals 1,000 feet) geologic map are the result of a study of the geology of an area of about 65 square km that lies on the southwestern flank of the Santa Ana Mountains about 25 km east of the Orange County Civic Center. The southern half of the map area lies outside the Cleveland National Forest and is dominated by mesa-like Plano Trabuco. The northern part of the area lies within the Cleveland National Forest and is dominated by west-trending Silverado, Williams, Harding, and Santiago canyons and a jumble of intervening ridges.

OFR 84-59 LA. Preliminary Geologic Map of the California-Baja California Border Region. Compiled by James E. Kahle, Paul A. Bodin, and George J. Morgan. This report consists of an 8 page text, a geologic map (Plate 1) at a scale of 1:250,000, and a geologic legend (Plate 2). This geologic map covers the region extending from approximately 31° 30' to 33° 30' north latitude and 114° 30' to 117° 45' west longitude. It includes adjacent portions of Arizona and Sonora, Mexico, as well as faults and structure offshore. The geology is shown on a planimetric base and is current through 1975. Minor modifications of geologic detail and the locations where fault rupture has occurred, through 1984, are also shown.

SACRAMENTO REGIONAL OFFICE

OFR 83-37 SAC. Mineral-Land Classification of Auburn, 15-Minute Quadrangle, El Dorado and Placer County, California. By S.L. Kohler. Maps, scale: 1:48,000. Important mineralized areas within the Auburn 15' quadrangle include a high calcium industrial-grade limestone deposit which is currently being mined; a three-square-mile chromite deposit known as the Flagstaff Hill mining district; and the historical Ophir gold mining district, most of which has or is currently undergoing rapid urbanization.

OFR 84-25 SAC. Induced Seismicity at Lake Oroville, California. By T.R. Toppozada and C.H. Cramer. 14 pages, 5 tables, 9 figures. The seismicity near Lake Oroville was reviewed in detail and was related to the local geology and to the variations in water level of the lake. The seismicity following the 1975 Oroville earthquake (M5.7) was reviewed in detail to determine how it varies with variations in water levels in the lake. Lake Oroville was compared to a similar neighboring lake, to determine the effect of site geology and reservoir storage on seismicity. The study, which was partially funded by the U.S. Geological Survey, provides insight into the nature of reservoir induced seismicity.

OFR 84-29 SAC. Geothermal Resources Investigations of the Sonoma Valley Area, Sonoma and Napa Counties, California. By Linda F. Campion, C. Forrest Bacon, Rodger H. Chapman, Gordon W. Chase, and Leslie G. Youngs. This report sets forth a summary of the results of three years of study, by the Division of Mines and Geology (DMG), of the geothermal resources of the Sonoma Valley area in Sonoma and Napa counties. This final "wrap-up" study includes data developed in the earlier studies, as well as temperature data from new shallow drilling. It provides a comprehensive assessment of the geothermal resources for the entire Sonoma Valley area, and summarizes the historical development of the geothermal resources in the Valley and the results of geological, geophysical, geochemical, geothermometric, seismological, and temperature measurements investigations.

OFR 84-32 SAC. Geothermal Energy at Long Beach Naval Shipyard and Naval Station and at Seal Beach Naval Weapons Station, California. By Chris T. Higgins and Rodger H. Chapman. As part of an agreement with the U.S. Department of Energy and the U.S. Department of the Navy, the Division of Mines and Geology studied possible sources of geothermal energy at the two naval bases in southern California. The results of the study are intended to aid the Department of the Navy in its program to reduce its use of petroleum by the development of other sources of energy. Temperatures beneath each base appear insufficient to encourage drilling of geothermal wells at this time, particularly for generation of electricity; the conductive geothermal gradient at Long Beach is about 5.6°C/100 meters, while at Seal Beach it is about 4.0°C/100 meters. Each base, however, overlies parts of oil fields, the wells of which individually produce oil and saline water at temperatures up to about 160°-165°F. These facilities are the most significant sources of geothermal energy at either naval base.

OFR 84-50 SAC. Mineral Land Classification of the Folsom 15' Quadrangle, Sacramento, El Dorado, Placer, and Amador Counties, California. By R.C. Loyd. 1984. 44 pages, 8 plates. Results of this study indicate that in addition to limestone, which is currently being mined within the Folsom quadrangle, geologic environments favorable for the occurrence of lode gold, placer gold, copper, zinc, chromite, clay, industrial sand, and lignite exist within the quadrangle.

OFR 84-53 SAC. A Detailed Microearthquake Survey of Long Valley, California, Known Geothermal Area, July-September, 1981. By C.H. Cramer, D.J. Stierman, and T.C. Lee. This is the final technical report of a co-operative study by the U.S. Department of Energy, the California Division of Mines and Geology, and the University of California, Riverside. The goal of this study was to evaluate microearthquake analysis as a tool in geothermal exploration by conducting a state-of-the-art microearthquake survey of a known geothermal area. This report has sections presenting analyses of (1) microearthquake locations, (2) magnitude determinations and frequency versus magnitude relationships, (3) velocity structure from arrival time inversion, (4) focal mechanisms, and (5) spectra. Other geophysical and geological data for Long Valley are also presented, discussed, and integrated into the report as part of the overall evaluation of the microearthquake survey.

OFR 84-54 SAC. Evidence of Recent Faulting along Owens Valley, Round Valley, and White Mountains Fault Zones, Inyo and Mono Counties, California. The report (a brief text and two maps) identifies and summarizes the principal evidence for recent faulting (latest Pleistocene to Holocene) along the Owens Valley, Round Valley, and White Mountains fault zones. The mapping was conducted by the Division's Fault Evaluation and Zoning Program, under the Alquist-Priolo Special Studies Zones Act.

OFR 84-55 SAC. Evidence for Recent Faulting along the Mono Lake Fault Zone, Mono County, California. The map identifies and summarizes the principal evidence for recent faulting (latest Pleistocene to Holocene) along the Mono Lake fault zone. The mapping was conducted by the Division's Fault Evaluation and Zoning Program, under the Alquist-Priolo Special Studies Zones Act.

OFR 84-56 SAC. Evidence of Recent Faulting along the Antelope Valley Fault Zone, Mono County, California. The attached map identifies and summarizes the principal evidence for recent faulting (latest Pleistocene to Holocene) along the Antelope Valley fault zone. The mapping was conducted by the Division's Fault Evaluation and Zoning Program, under the Alquist-Priolo Special Studies Zones Act.

3. Geology library

The Division's library, located in the San Francisco Bay regional office in Pleasant Hill, is a research and source facility for the Division's professional staff. The books, periodicals, maps, and government documents in the collection represent an up-to-date, comprehensive selection of materials of use to Division scientists and investigators.

4. Critical-siting report review

The Division provides reviews of geological, seismological, and mineral resource aspects of technical reports produced by other state, federal, and local government agencies. The purpose of the DMG reviews is to provide assurance to those agencies that the treatment of the geological, seismological, and mineral resources aspects of those reports has been thorough and accurate, and has

applied state-of-the art technical methodology with respect to any geological hazard or mineral resource issues that may be present. Technical information and interpretive judgments are brought to bear in the review process. During fiscal year 1984-85 siting report review activities included California Coastal Commission site reviews, review of hospital sites, and analysis of Environmental Impact Reports (EIR). Reimbursements for work done by the siting report review unit were provided by the Office of the State Architect and the California Coastal Commission.

Project documents that come under review are treated as either "routine" or "major" documents. Major documents are those that require multiple reviews by different specialists within the Division. Of the 6,000-plus documents reviewed during fiscal year 1983-84, 60 involved major document review.

a. Coastal Commission site reviews

A contract with the California Coastal Commission provides for Division staff to review the geologic and seismic safety of proposed developments when requested by the Commission. Reimbursement is on a case-by-case basis, and Division review requires a site visit as part of the engineering geologic appraisal. Most of the work is in southern California where intensive development is occurring in areas of potentially unstable sea cliffs.

b. Environmental impact report reviews

The Division continued to review Environmental Impact Reports (EIRs) for a variety of projects, outer continental shelf projects including subdivisions, school sites, mining activity, dam sites, and hazardous waste disposal sites. The problems considered in the review are earthquake shaking, fault rupture, landsliding, erosion, expansive soil, tsunami, subsidence, volcanic eruption, mineral resource conservation, and mined-land reclamation. The Division's EIR guidelines are presented in DMG Note 46.

c. Hospital site report reviews

The Division continued to review reports under the provisions of the Hospital Safety Act (Health and Safety Code), which became effective March 7, 1973. This Act requires that new hospitals, including additions, reconstructions, and out-patient facilities, be functional during and after an earthquake or other natural disaster. The Division reviewed new and supplemental geologic/seismic hospital-site reports that were submitted by consulting engineering geology firms to the Office of the State Architect. Along with the review activity, Division staff continued to attend regular meetings of the State Building Safety Board and the geotechnical subcommittees to develop new administrative regulations.

d. Legislation review

Division staff continued the review of State Assembly and Senate bills. The most intensely reviewed bills related to a landslide hazards mapping program and the disposal of toxic waste and low-level radioactive waste in California.

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